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Engineering News

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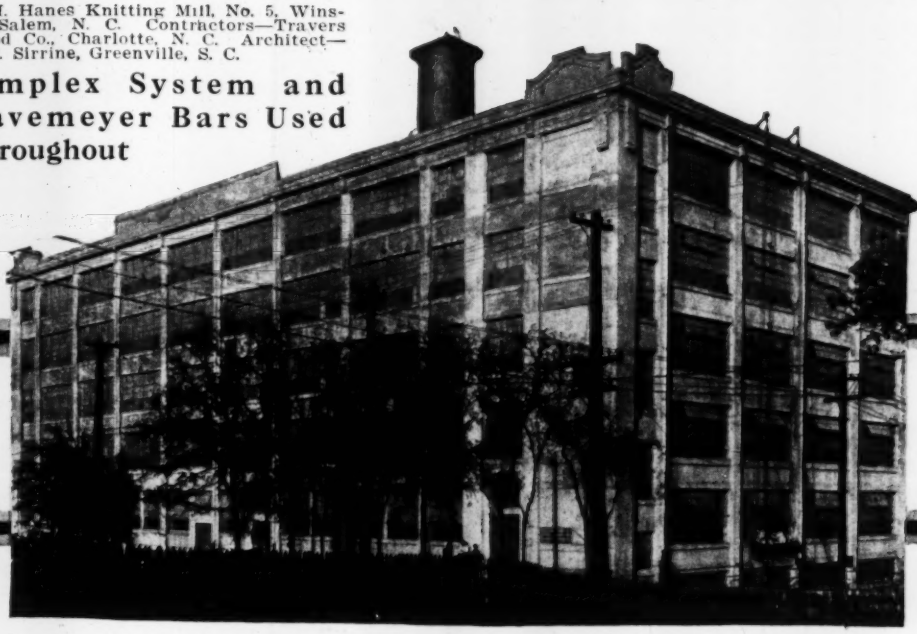

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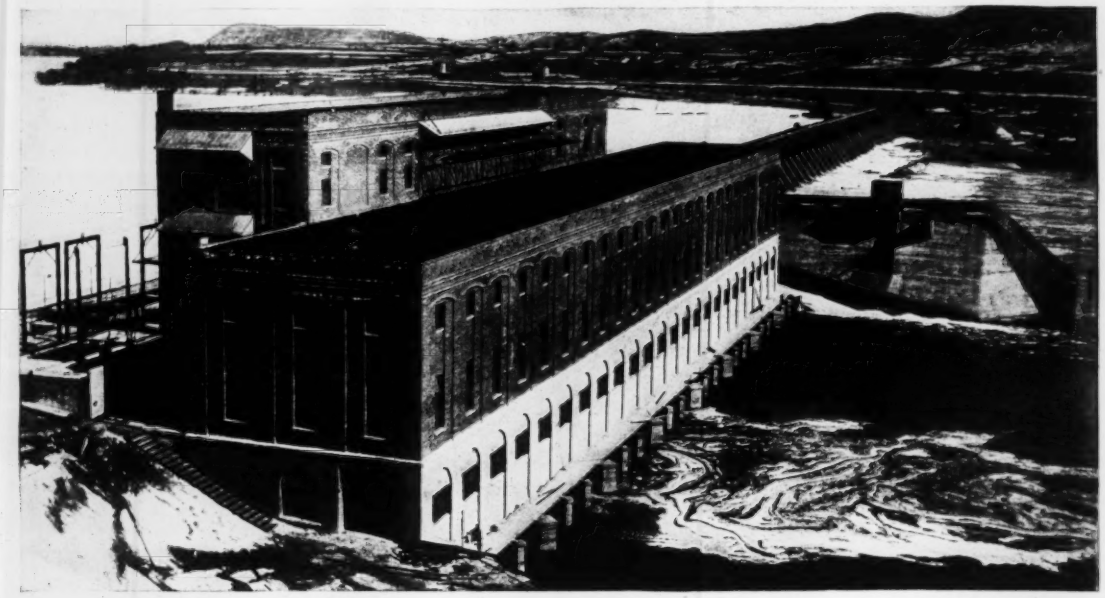


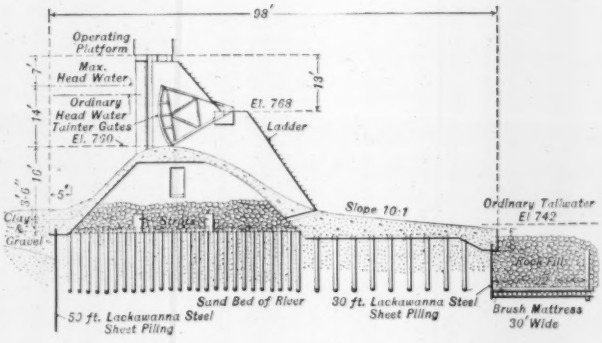
Dam and Power House Built on Deep Sand. Foundations Protected By Lackawanna Steel Sheet Piling.

Borings to the depth of 50 feet failed to indicate rock or hard material on the site of this hydro-electric plant, Wisconsin River Power Co., Prairie du Sac, Wis., so both building and dam were supported on round bearing piles, and the site protected by permanently installed walls of Lackawanna Steel Sheet Piling.

The entire area of the power house, 329 by 145 feet is so enclosed, the Lackawanna Steel Sheet Piling being driven to 50 feet depth in the upper line, 15 feet in the lower line and 40 feet in the line between power house and lock. An intermediate line of steel sheeting 15 feet in depth was also driven about 50 feet below the upper line.

The dam is 1,000 feet long and of the hollow concrete type. The sand beneath is confined between two walls of Lackawanna Steel Sheet Piling, one of 50-foot penetration under the upstream face and the other 30 feet deep under the apron. The tops of both of these lines of sheet piling are capped into the concrete, a construction that adds greatly to rigidity.

This dam and building were completed by the contractor, James O. Heyworth, Chicago, in January, 1915, after contending with difficult winter conditions, periods of high water and at least one large flood. The fact that since completion, floods of 4 to 5 feet of water have at times poured over the crest of the dam without any appreciable injury to the construction, would seem to indicate that the Lackawanna Steel Sheet Piling is doing good work.



If you are interested in subaqueous foundation work, get our book "Lackawanna Steel Sheet Piling" and if you want it, the free advice of our Steel Sheet Piling Engineers.

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Engineering News

VOLUME 77 JANUARY 11, 1917 NUMBER 2

Willamette Pacific Railroad; A New Line Through the Coast Range

By W. P. Hardesty*

The one natural water-grade route connecting the interior of Oregon with the Pacific Ocean is that down the Columbia River. This route has long been occupied by a railroad. However, besides the mouth of the Columbia River there are several bays along the Oregon coast affording access to ships of limited draft, which are susceptible of improvement to provide facilities for larger vessels. The connection of these bay districts by rail with the great interior, including the Willamette Valley and Portland, is an important step in the development of the country, more especially as the railroads must traverse virgin country rich in various resources. The Willamette Pacific R.R. is the latest, and also the most interesting from an engineering standpoint, of the railroads reaching the Oregon coast. The company was incorporated to build a road from Eugene, on the main line of the Southern Pacific between San Francisco and Portland, lying 123.7 mi. southerly from Portland to Coos Bay, which is about two-thirds the way from the mouth of the Columbia southerly toward the Oregon-California line, lying southwest of Eugene. The length of line to Marshfield, the Coos Bay terminus, is 121.6 mi. The road runs nearly west from Eugene for about 70 mi. until the coast region is reached, then turns southerly and proceeds (at a distance of from 3 to 6 mi. back from the ocean shore) to Marshfield.

FIG. 1. VIEW LOOKING NORTH FROM TUNNEL NO. 2, WILLAMETTE PACIFIC R.R.

The first 17 mi. west of Eugene is over the flat Willamette Valley. Then begins the ascent of the Coast Range. With some development the line reaches the site for Tunnel No. 1, piercing the backbone of the range. This tunnel is 2,489 ft. long, and the easterly end is on an 8° curve. At the westerly end of the tunnel the summit grade elevation of 578.5 ft. above sea level is reached, a climb of only 178 ft. from the floor of the valley. There is a continuous descent for the next 8 mi. (to about M.P. 30), a drop of 186 ft., after which a slightly undulating grade is used. Approaching the bridge at M.P. 35, the first crossing of the unique Siuslaw River is made. This stream is followed for nearly 35 mi., being crossed seven times. The Siuslaw for a long distance flows over a bed of ribbed sandstone, with no addition of sand, gravel or earth. Tidewater reaches up the narrow valley or cañon of this river for some 20 mi. from the ocean, to about M.P. 56. At M.P. 58 is the old settlement of Mapleton, long the connecting point between the stage trip from interior Oregon and the voyage by launch or boat the remainder of the distance to the sea. The Siuslaw River gradually widens into a bay; above the upper end of this, the railroad crosses to the southerly side on a drawbridge and runs nearly parallel to the coast. The natural route is along a string of freshwater lakes, surrounded by wooded ridges. These lakes are slightly higher than the ocean and drain into it by connecting outlets. Lakes Tsiltcoos and Tahkenitch are most noteworthy, being followed for about 15 mi., and the various arms are crossed on trestles. These two lakes are separated by an isthmus, requiring a low summit in grade.

At about 90 mi. from Eugene the Umpqua is approached. This is one of the largest rivers in Oregon, and it heads on the Cascade Range, cutting entirely through the Coast Range. The railway crosses the estuary of this river on a steel structure over a quarter

*Portland, Ore.

of a mile long, between the stations of Gardiner and Reedsport.

The line continues on southward, passing through the low divide south of the Umpqua to reach the next series of lakes by a summit cut and a tunnel 1,183 ft. long. After passing North Lake and Ten-Mile Lake (some miles in length) another drainage divide is passed and Coos Bay is reached. Nowhere on this stretch of over 50 mi. along the coast is a grade elevation of over 78 ft. above low tide required, due to the frequent use of tunnels.

Coos Bay is crossed on a steel structure with pile-trestle approaches aggregating almost a mile in length. The cities of North Bend and Marshfield are thus reached, lying on the southwesterly side of the bay.

Construction Features

This railway was intended primarily as a branch line or feeder of the Southern Pacific. Unusually rigid requirements have resulted in a road really adapted to forming part of a main line, if it should ever be desired to extend it down the coast into California.

The standards of construction fixed maximum curves at 8° (with two exceptions of 10° curves); maximum grades 0.6%, with compensation on curves varying from 0.035% per degree up to 30° to 0.050% per degree for the 10° curves. The track is superelevated for a speed of 45 mi. per hr. up to curves of 6°, for 35 mi. on 8° curves and 25 mi. on 10° curves. All curves of 2° and

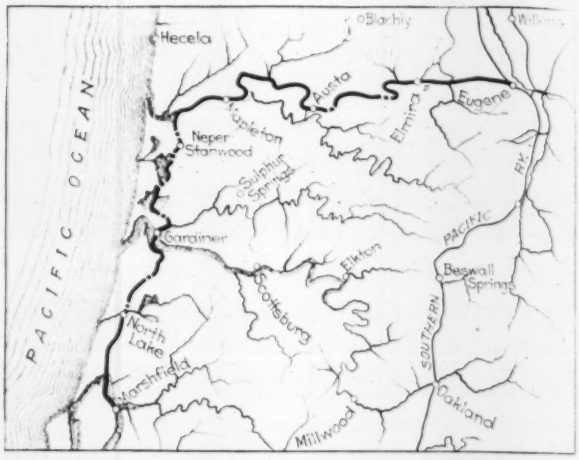
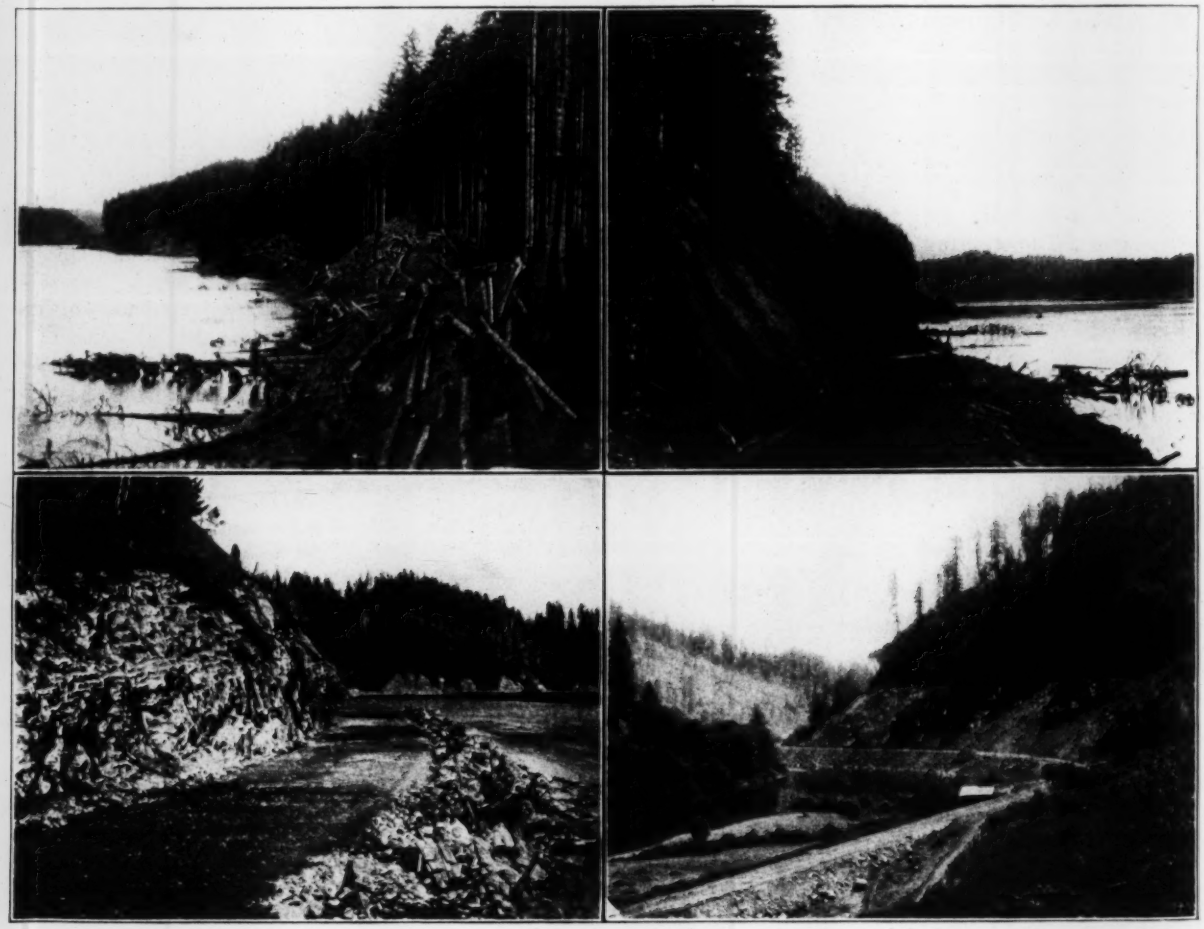


FIG. 2. MAP OF PART OF OREGON, SHOWING WILLAMETTE PACIFIC R.R.

sharper are spiraled with Hood's easement curves. Bridges and trestles are designed for the same loading as on the main line of the Southern Pacific. The roadbed is 18 ft. wide in fills and 20 ft. in firm cuts, but in places as much as 25 ft. in sand cuts, because of drifting in.

The materials encountered in grading were mostly clayey soil on the east side of the summit, while on the west slope much of the excavation was in sandstone.



FIGS. 3 TO 6. CONSTRUCTION VIEWS OF THE WILLAMETTE PACIFIC R.R. THROUGH VIRGIN TIMBER COUNTRY

soft and crumbly sandstone and also ordinary sand. Slopes varied from ½ on 1 in sandstone to 1 on 1 in firm earth and loose rock and to 1¾ on 1 in loose sand. Embankments were all built with 1½ on 1 slopes.

Owing largely to the frequent use of tunnels, and also because the location was exceedingly carefully and closely made to secure the proper balance of quantities, the maximum grades and the grading were lighter than might be expected. The following were the total quantities of different classes of materials:

	Cu.Yd.
Earth	2,439,716
Cemented material	660,230
Loose rock	97,959
Shale and similar rock	2,904
Sandstone	821,810
Soft sandstone	823,685
Boulders	100,712
Other solid rock	11,464
Total	4,958,480

The deepest fill was 51 ft., the highest cut 63 ft., the largest cut 108,526 cu.yd. and the largest fill 92,578 cu.yd.

Tunnels Frequently Constructed

In all, there are nine tunnels, 475 to 4,183 ft. in length. Their total length is 11,001 ft., or 2.65 mi. Tunnel No. 1 is at the summit of the Coast Range; No. 2 is on the westerly slope, while all the remainder are on the stretch of railway parallel to the coast. The tunnel cross-section used is the standard of the Southern Pacific, giving a net size of 17x22 ft. The material encountered was usually a sandstone, often soft or given to "slacking" when exposed to the air, so that timbering followed closely.

The timbering is according to the Southern Pacific standards. Timber sets of 10x14-in. fir with three-segment arches were used. The posts each rest on separate mudsills. No wall plates are used, and the tops of the posts are fitted to the inclined segments by wooden dowel pins. The top segments are placed and the joints blocked from the roof until in correct position and tight. By this method each timber set is entirely independent of the others and may be removed and replaced, sill and all. Lagging was used as required. In bad ground the usual spacing of 4 ft. c. to c. between sets was reduced to 3 or 2 ft.

It was the original intention not to line any part of the tunnels with concrete, but this was changed during construction so that in most places a concrete portal and lining extends in 50 to 100 ft. from each end. The face of the lining is flush with that of the posts, with a full circular arch. Each concrete portal was formed with the usual parapet bulkhead, with longitudinal step down walls for retaining the earth at the sides.

Trestle Construction

Fir-timber trestles were used at many crossings of gulches and water and as approaches to steel structures. They are of standard five-pile bents with 15-ft. spans. The highest is a four-story trestle, used at a creek crossing near the easterly end of the summit tunnel.

The approach to the Coos Bay bridge is a ballasted-deck trestle, about four-fifths of all the piles of which are of cedar, and the remaining one-fifth of creosoted Oregon fir. The caps and bracing are of cedar, while the stringers and the rest of the deck structure are of fir. On the stringers is laid a floor of 3x12-in. plank; on this is placed roofing paper, followed by a coat of asphalt, and then 15 in. of crushed gravel ballast, 8 in. being under the ties.

The cedar piles of the trestle approaches to the Coos Bay bridge are protected against the teredo and other marine borers as follows: A casing of concrete is built around each pile from about 3 ft. below the bottom to about high tide. Where this line came on the bracing, the latter was also protected by the concrete covering.

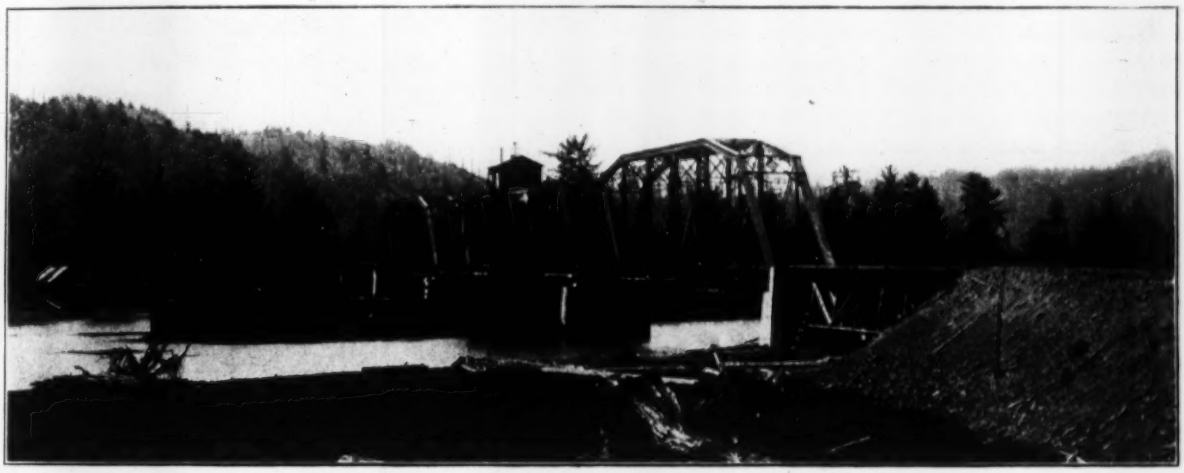


FIG. 7. SEVENTH CROSSING OF THE SIUSLAW RIVER

The total length of wooden trestles used on the road was 28,720 ft. or 5.44 mi. On all trestles the points of contact of the members were first coated with carbolineum.

Along the string of lakes near the coast, alluvial beds of much depth were found, so that piles of great length were necessary. Some ran as much as 138 ft. after the cutoff, which is believed to be the record for single piles. In order to provide greater bearing at very soft places, bents of seven and even nine piles were used.

Steel Bridges

The western side of the Cascades in Oregon is well watered, so that frequent stream crossings were necessary. In all, there are 31 steel bridges, varying from 60 to 2,208 ft. in length. The total length of these structures is 8,134 ft., or 1.54 mi. These contain 9,100 tons of structural steel, while the substructure parts required 10,000 cu.yd. of concrete.

The Long Tom River is crossed four times, Wild Cat Creek seven times, Siuslaw River seven times, Umpqua River and Coos Bay each once. Spans of standard design were used for the bridges where possible, but some special spans were required because of local conditions. The largest structures were required in crossing the three estuaries on the section running down the coast—namely, Siuslaw River, Umpqua River and Coos Bay.

The Siuslaw drawbridge consists of two 200-ft. through pin-connected spans and a 286-ft. swing span, making a total length of 695.6 ft. The pivot pier varies from 29.7 ft. at the base to 26 ft. in diameter at the top. The track elevation is about 26.5 ft. above low tide.

In building the pivot pier for each of the drawbridges, built-up sheetpiling in three layers of 4x12 in. was first driven. A steel guiding frame was used to maintain the circular shape, and a steel arc or hoop was placed on the outside to hold the sheetpiling against the guiding frame. The excavation to the required depth for the bottom of the concrete was then made with a bucket dredge and a special type of sand ejector, after which the piling foundation was driven, with the piles averaging about 3½ ft. c. to c.

In pouring the concrete for the piers of all these bridges the Southern Pacific practice was followed. The piles were not cut off at the base of the concrete, but at about extreme low water, the ends thus being embedded in the concrete. The reasons for this are that the joints between different pourings of concrete (12 hr. or often several days apart) are difficult to make so as to secure a good bond, especially where they come under the water. The embedded piles resist the tendency to shear along these joints in the case of any great lateral pressure. The piles also lessen the amount of concrete required. A small bucket was used in lowering concrete between the piles.

The Umpqua River bridge consists of nine 125-ft. fixed spans and one 348-ft. swing draw span, making a total of 1,473 ft. Only one of the fixed spans is south of the draw span. All are through spans of riveted truss members. The bottom of concrete in the pivot pier is 28½ ft. below ordinary low tide. Each opening of the draw is 150 ft. in the clear.

The Coos Bay bridge consists of nine 150-ft. and two 180-ft. through riveted spans, with one swing draw of 458 ft. The total length face to face of back walls is 2,208 ft. In addition, on the north end is a trestle approach of 30 bents and on the south end one of 168 bents, so that the total length of structures and approaches is 5,181 ft. The trestles have ballasted decks, all timber, but the decking is of cedar except as before described.

The swing span has a clear opening of 200 ft. each side of the pivot pier. The concrete in the latter extended 10 ft. below ordinary low tide, and the average cutoff of the piles was 2 ft. below ordinary low tide, being slightly below extreme low tide.

The concrete in the pivot pier of this (also the other drawbridges) was a 1:2:4 mixture up to low tide and of 1:2:6 above.

Besides the three main drawbridges described, other openings for the passage of miscellaneous traffic were provided. At several points on the wooden trestles crossing the different lakes and channels along the coast, steel plate girders of a span of 27 to 30 ft. were placed. These will permit barges containing engines and other equipment for logging operations to be passed. The pile bents supporting the ends of these girders were made correspondingly substantial, consisting of seven, nine and even eleven piles. In other places full draw spans were built, with hand-operated gearing. For these openings the logging companies are obligated to give the railroad company 24-hr. notice, so that men may be sent to open the draw.

The track was built with 7x8-in. by 9-ft. ties spaced 18 to standard rail length of 33 ft. New 75-lb. rails were used.

For all of the line north and east of the Umpqua River sawed fir ties were used, except for about 5 mi., where hewn fir ties were laid. For the part south of the Umpqua (about 30 mi.) Port Orford cedar ties were laid, with tie plates. The tie plates were used elsewhere on the road on curves of 2° and sharper.

On the westerly side of the summit, along the Siuslaw River above Mapleton, the location for long distances overlapped the highway. The railroad company was obliged to rebuild long sections of this highway in a new position, higher up. Altogether, 15 or 16 mi. were rebuilt, and in many places this work cost more than the railroad grade adjacent.

Methods and Organization

Work on through surveys started in 1910, and the first unit of construction was put under contract about Nov. 1, 1911. Inaccessibility of part of the country, together with the long rainy seasons, tended to delay progress. The portion put under operation, for commercial purposes as well as for construction, was gradually extended westward from Eugene. For that part south of the Umpqua, materials and supplies were brought from San Francisco to Coos Bay by sea, so that the closing was at the Umpqua bridge, and this was the last part of the road to be completed. The road was opened for its entire length in August, 1916. It is being operated as the Coos Bay branch of the Southern Pacific. Though no details are available, it is understood that the new railroad cost between $10,000,000 and $11,000,000.

The first contract, covering 25 mi. out from Eugene and including Tunnel No. 1, was executed by Twohy Brothers, of Portland, Ore. The remainder of the road (exclusive of bridges) was let to MacArthur, Perkes & Co., of New York City, and by them sublet to Porter Bros.-Grant Smith Co., who in turn sublet to many others.

The railroad company with its own organization and equipment did all the substructure work on bridges, also all bridge-deck work, trackwork and painting of bridges. The erection of the steel bridges was let to McCreary & Willard, except the Siuslaw bridge, which was erected by the company's own forces.

The engineering work was conducted by the Southern Pacific Co.'s regular organization. The chief engineer, William Hood, directed operations from San Francisco. The principal assistant engineer in charge was H. P. Hoey, who with W. R. Fontaine, assistant engineer, handled the work from Eugene. The three drawbridges and other bridges south of the Siuslaw were constructed under supervision of C. R. Broughton, with headquarters at North Bend. To these and their assistants the writer is indebted for data from which this article was prepared.

Adapting the Motor Truck to Its Work

First-Prize Motor-Truck Maintenance Article in the "Engineering News" Prize Contest

By Clarence B. Montgomery*

Most business men, turning from horses to motor trucks for delivery service, have depended on their judgment, biased more or less by the arguments of truck salesmen, for the solution of the variety of problems that arise—what kind, size and make of truck to buy, selection and payment of drivers, safe speeds and loads, housing, repairs, tires, costs, etc. This has resulted, during the past five years, in much expensive experimenting which may now be largely eliminated by drawing on variously accumulated experience. The writer has had charge of one of the largest fleets of trucks in Philadelphia for the past four years (that of the Union Paving Co.) and in addition has made a study of truck transportation in general, which perhaps justify an attempt to outline answers to the above problems of the uninitiated.

Selection of Truck

The respective fields of gasoline and electric trucks are so clearly defined that only passing mention need be made of the electric vehicle. The present cost of current and limitations of construction greatly restrict the use of electric trucks.

The size (capacity) of truck and type of body will be determined by the nature of the business. Where a large quantity of material is to be moved, the five-ton truck should be chosen. For delivering in smaller quantities or for distributing a load to several points a two-ton truck will be most economical. Light delivery cars occupy a separate field and will not be discussed here.

The body should be built as low as chassis construction will permit. All unnecessary weight should be eliminated. In dump bodies the power hoist is more economical than the hand-operated one.

Regarding the make of truck, the writer's company strongly condemns the "low-first-cost" trucks. A buyer is more than justified in paying a higher price to get a reliable, well-known, standard truck. The practice of buying trucks of several makes for comparative purposes is not favored. Select what you find to be the best truck and then standardize. The saving through interchangeability of parts is self-evident.

We have tried both wood and metal wheels and greatly prefer the latter. Tires give greater mileage over metal wheels, and wheel troubles are entirely eliminated. Tires are supplied of two types—demountable and pressure-applied. The pressure-applied type will be found more satisfactory and should be specified unless the truck is to work in some remote section, inaccessible to a service station.

The truck should be lettered with the owner's name, and if more than one truck is used, with a distinguishing number. This number should also appear prominently on the back end of the body, as it is often desirable to identify a vehicle when only the rear end is visible.

After the truck has been selected and equipped, we may turn our attention to the details of efficient operating. The frequently expressed opinion that teamsters make the best truck chauffeurs is not borne out by experience. The model truck driver is one who has served some time in a machine shop or garage, young, preferably married, with at least a fair schooling, temperate and honest. Drivers should be paid a definite weekly wage. In addition, they should receive a monthly bonus, based on the miles traveled and the amount of gasoline used. This bonus stimulates interest and coöperation in the driver, the most vital factor in profitable operation.

Overloading and overspeeding are two prominent pitfalls to be avoided. Abusing any machine is short-sighted economy. But speed governors are not to be generally recommended; a good driver does not need a governor, and a poor driver can ruin a car in spite of one.

Under suitable conditions hauling costs may be reduced 15% to 25% by pulling a trailer in back of the truck. This should not be attempted where grades over 10%, or bad road surfaces, are to be encountered. When using a trailer, the truck ought not to carry over 80% of its rated load, while the trailer may take an equal amount or slightly over.

Where three or more machines are kept, the owner should have his own garage, in which practically all repairs can be made. Here a supply of gasoline and oil may be kept as well as extra brake bands, two spare wheels (one front and one rear) and other minor parts. Three mechanics should keep 10 or 12 machines running. This will be possible by a system of continuous maintenance, a thorough overhauling yearly and discarding trucks when they are worn badly.

Cost Keeping

Accurate costs should be kept on every truck installation. The extent of detail will be determined by the number of trucks used and the relative cost of hauling compared to the entire cost of the material delivered. Most tire and truck companies distribute blank forms for recording daily costs. These are all similar in essentials and furnish an excellent basis for an accounting system.

The accompanying table shows a typical cost statement for a five-ton dump truck, giving each item entering into hauling costs and the necessary averages.

COST STATEMENT FOR FIVE-TON DUMP TRUCK

Fixed Charges	Per Day
Depreciation* ($4,100-$400 scrap value ÷ 1,200 days)	$0.46
Insurance (liability, fire and collision)	.58
License fee	.10
Truck foreman (supervising three trucks)	1.25
Driver	3.00
Total fixed charge per truck	$5.39

Variable Charges	Per Mile
Depreciation* ($4,100-$400 scrap value ÷ 50,000 mi.)	$0.0629
Gasoline @ 25c. (3 mi. per gal.)	.0833
Lubricating oil (64 mi. per gal.)	.0055
Tires (on guarantee basis)	.0386
Repairs	.0600
Total variable charge	$0.2503
Fixed charge (at 50 mi. per day)	.1078
Total cost per mile	$0.3581
Total cost per day	17.91
Total cost per ton-mile	.1433

* About 15% of the first cost depreciates with the passage of time, while about 85% is directly proportional to the miles run.

*1447 N. Edgewood St., West Philadelphia, Penn.

Five Water-Works Make Filter Alum—II

SYNOPSIS—Bauxite is treated with sulphuric acid by the cold process, producing alum cake, which is broken into lumps. The evolution of the process was outlined, and plants at Columbus, Ohio, Trenton, N. J., and Springfield, Mass., were described in "Engineering News" of Jan. 4, 1917. The Omaha plant, here described, differs from the others in some interesting details.

Omaha Installation Described

By George T. Prince*

The alum-making plant at the Florence station of the Metropolitan Water District of Omaha, Neb., has been in regular service since Aug. 19, 1916.

Bauxite, which is mined in Arkansas, is delivered at Florence, Neb., in box-cars. As it is received, about 95% will pass a screen of 1-in. mesh. It is unloaded from the cars by hand power and barrows and deposited upon the main floor, in the south end of the building at El. 80 (which elevation corresponds with that of the floor of the car), at a cost of 15c. per 2,000 lb. From the main floor the bauxite is shoveled through a 1x4-ft. floor grating of ¾x1½-in. iron bars, spaced 1 in. apart, into a 50-cu.ft. sheet-iron storage hopper. From this it is automatically fed into a mill (Figs. 4 and 5) that pulverizes it to a fineness resembling portland cement.

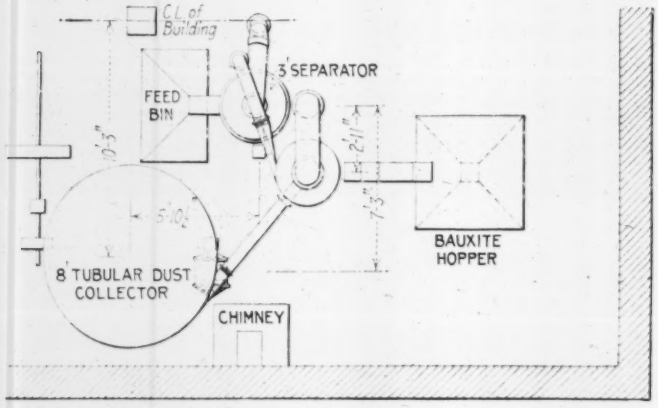
The pulverizer is placed on the floor of the basement, El. 70, directly below where the bauxite is stored. It is operated by a 25-hp. 3-phase 220-volt 60-cycle motor, running at 1,200 r.p.m., the mill running at 3,000 r.p.m. After passing the pulverizing mill, the bauxite is discharged into a cyclone collector and elevated by means of a bucket elevator into a steel storage bin having a capacity of about 60 cu.ft. The elevation of the top of this bauxite storage bin, which is hopper shaped, is 90.5 ft., and that of the bottom 84.5 ft.

From this storage bin the bauxite is drawn through a short vertical pipe into a weighing hopper (Fig. 6) having a capacity of 18.5 cu.ft., to which is adjusted a weighing apparatus. The flow of bauxite into the weighing hopper is regulated by a slide valve placed in the short vertical inlet pipe. The elevation of the top of the bauxite-weighing hopper is 84 ft. and that of the bottom 80.5 ft. From the weighing hopper the bauxite passes to the mixing pan, at a little lower elevation, its center being about 2.5 ft. to one side of the center of the weighing hopper.

Sulphuric acid is received at Florence in tank-cars containing approximately 55 tons, which weights are adjusted to conform with 60° Bé. acid, upon which adjusted weights payment is made. The tank-cars are unloaded by means of air pressure generated by a compressor driven by a 2-hp. motor. This compressor is placed on the main floor (El. 80) near the bauxite-weighing hopper and operates against a resistance of about 30 lb. per sq.in.

The acid is unloaded into a storage tank, 7 ft. 3 in. internal diameter and 35 ft. long, placed north of the north wing of the building and about

*Chief Engineer, Metropolitan Water District of the City of Omaha, Neb.



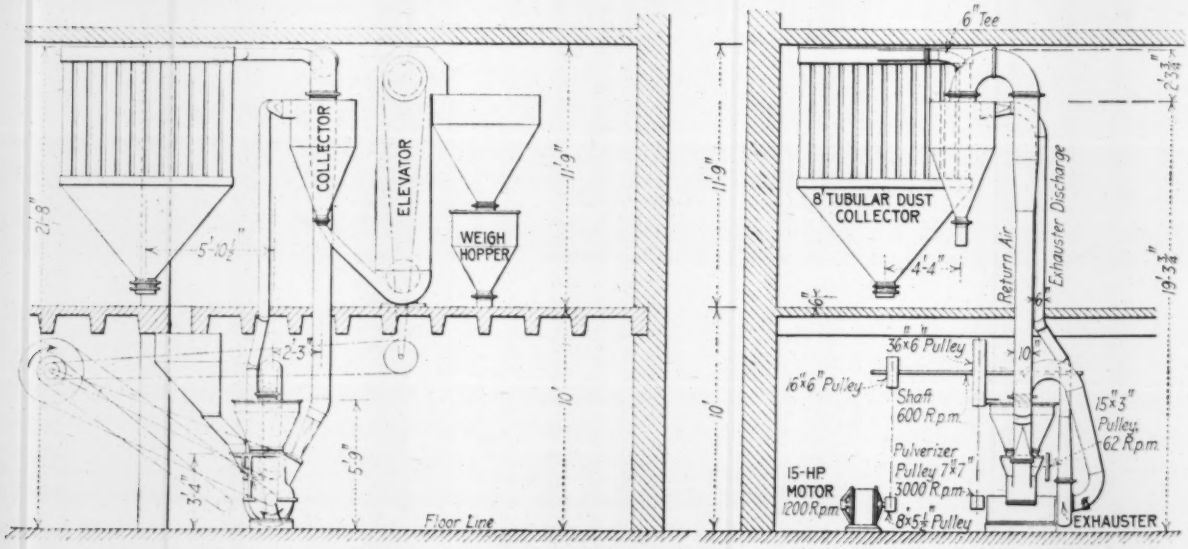


FIG. 4. DETAILS OF BAUXITE PULVERIZER, OMAHA ALUM PLANT

300 ft. from the air compressor. It is supported upon concrete pedestals about 3 ft. above the ground. Below this tank is a brick-lined pit in which is placed a cast-iron egg having a capacity of 20 cu.ft. and connected by suitable piping with the storage tanks.

The acid is drawn into the egg from the storage tank by gravity, and by means of air pressure is forced from the egg through 1½-in. lead pipe into a lead-lined wooden cooling tank that has a storage capacity of 115 cu.ft. and is located outside of and north of the east end of the main portion of the building, about 25 ft. from the mixing pan. The elevation of the bottom of the cooling

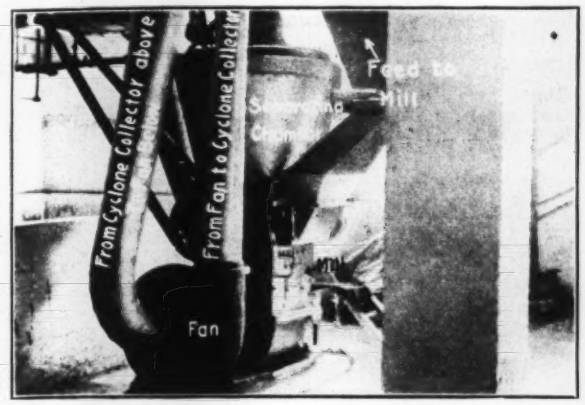


FIG. 5. BAUXITE PULVERIZING MILL, OMAHA ALUM PLANT

tank is 87 ft. The tank will store 13,000 lb. of 52° Bé. acid.

The acid purchased is approximately 60° Bé., whereas the gravity desired in the mixing process is 51° to 53°. If 60° Bé. acid were applied to the bauxite in the mixing pan, chemical action would at once ensue in the pan, causing the volume to increase fivefold and overflow the pan, as it would be impracticable to empty the pan quickly enough to prevent it; hence it is necessary to dilute the acid by the addition of water. This is effected by discharging a calculated amount of water into the cooling tank when empty, and then a calculated amount of the 60° acid is added. The combination of acid and water generates considerable heat which, if present in the acid when mixed with the bauxite, would be liable to cause the mixture to overflow the pan in a manner similar to that above noted, were 60° acid used. Hence the office of the cooling tank is to allow the diluted acid to become sufficiently cooled before use to avoid reaction taking place in the mixing pan.

During the month of September about 36 hr. were required in which to cool the acid sufficiently for use. The duration of the cooling period will doubtless change with the seasons.

If acid could be purchased of 52° gravity, this cooling process could be avoided; but to date it has not been possible to do this, as the shippers claim that 60° is the limit at which it is safe or practicable to use steel tanks as containers, for below this limit the acid attacks the steel. This is in contradiction to positive statements to the effect that "chamber-acid" of about 52° Bé. is being transported and stored in steel containers, without injurious results.

From the cooling tank the acid is drawn by gravity, at a temperature varying from 80° to 103° F., into an acid-weighing steel hopper having a capacity of 28 cu.ft., to which is adjusted a weighing apparatus. This hopper is placed above the mixing pan and at one side of its center, in a manner similar to the placing of the bauxite-weighing hopper.

Mixing the Acid and the Bauxite

Acid is drawn into the mixing pan from the weighing hopper, in which it has first been weighed, the weight being indicated by a scale beam placed against the east end of the room near the mixing pan. Two steel revolving arms in the pan are then set in motion by the action of a 5-hp. 3-phase 220-volt 60-cycle motor running at 600 r.p.m., the arms revolving at 20 r.p.m., and bauxite is added to the acid in the proportion of one part by weight of bauxite to two parts of acid, based upon 52° Bé. acid.

The mixing pan is made of steel plates and has a capacity of 28 cu.ft. The upper portion has vertical sides and an internal diameter of 6 ft. The lower portion is conical in shape and at its lower extremity is supplied with a steel plug fitting into a cast-iron seat. This plug is operated by a bent lever, by means of which the mixture of acid and bauxite may be held in the mixing pan or discharged into the crystallizing box below. The top of the mixing pan is at El. 80.

The mixing-pan process requires not more than 5 min., after which the mixture is allowed to flow to the crystallizing box. The mixing pan is then washed

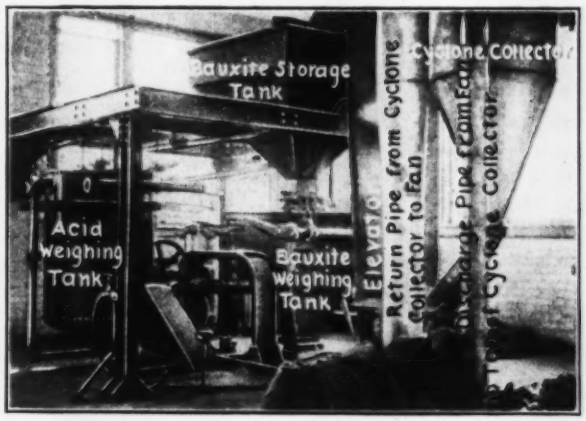


FIG. 6. MAIN FLOOR, OMAHA ALUM-MAKING PLANT

as clean as possible by a jet of water, the bottom opening is closed, and the pan is ready for another batch.

As above stated, the mixture is discharged into the crystallizing box, located in the basement at El. 70. This box is 13x25 ft. in plan, 3 ft. deep and is lined with concrete. In its west side, near the center, is built a wooden gate that is fitted with hinges and lock of the refrigerator-door type. The vertical joints at this door are first calked with jute before the crystallizing box is put into use.

About 20 min. after a batch has been discharged into the box, it begins to boil. The boiling continues for about 30 min., during which time the mass increases in bulk to nearly five times the space it occupied in the mixing pan, after which it gradually cools and hardens.

The cake is about 5 in. thick and when hard can be easily lifted from the floor of the pit by means of a bar and then broken into small lumps for use. It is afterward loaded into a wheelbarrow and removed to an adjoining storage room. To remove 9,000 lb. of the cake requires one man 8 hr. This work is divided between the day and the night man.

Cost of Finished Product

The plant is a success and produces an alum which is more basic than that formerly purchased and which is therefore more efficient for use in water purification.

Bauxite is delivered at Florence at $10.72 per 2,000 lb. and acid (60° Bé.) at $28. To make one ton of alum, composed of two parts of acid by weight to one of bauxite, would cost for materials $18.50. The equipment has cost $7,013, made up as follows:

Storage tank in place	$800
Acid-egg, including vault	100
Piping and valves	167
Cooling tank and inclosure	574
Steel hoppers, tanks, mixing pan, 5-hp. motor elevator and framing	1,836
Pulverizer	1,250
25-hp. motor	307
Scales	125
Sundry materials, including shafting and belting, also air compressor	400
Transmission transformers, wiring and labor	600
Concrete lining of crystallizing pit, including door	200
Labor, not included above	654
Total	$7,013

It will be noticed that, with the exception of the lining of the crystallizing pit, no item of building is included. The building contains apparatus for the preparation and application of lime and alum solutions to the water-supply, as well as for the chemical, bacteriological and physical laboratories.

Capital charges and minor repairs may be considered about as follows:

4½% interest on $7,013	$315.58
5% depreciation (15 yr., 4%)	350.65
Minor repairs	100.00
Per year	$766.23

Under the existing rate of consumption at Florence this would amount to $1 per ton of alum, which added to $18.94 makes $19.94 per ton of alum as the total probable cost at present prices, to which should be added cost of electric energy generated at the Florence station, estimated as 12c. per ton (1c. per kw.-hr.) making a total estimated cost of $20.06 per ton.

No charge is made for labor, as the usual force of two men, heretofore employed in mixing and applying the alum and lime, also attend to the pulverizing of the bauxite and making and removing the alum cake. The chemist supervises the proportioning of the bauxite and acid and has general charge of the purifying works. It takes one man 2¼ hr. to pulverize 3,000 lb. of bauxite. During this time he also looks after other work. It requires from 45 to 60 min. for two men to mix 9,000 lb. of alum and discharge it into the crystallizing pit.

After each batch of 9,000 lb. it is necessary for the attendant to spend about 30 min. chipping off hardened alum from the upper portion of the mixing pan. A slight reaction takes place at the surface of the mixture during the process of mixing, causing a hard scale to form. The lower portion of the pan can be kept free from this scale by a water jet after each batch.

So far as the pulverizing and mixing are concerned, the plant could turn out six tons of alum per 10 hr. To do this would require increased facilities for cooling the acid and disposing of the cake; hence the present nominal capacity may be considered as three tons of alum per 12 hr. The average amount of alum required at Florence is 4,000 lb. per 24 hr., distributed through the year. The maximum requirement is about 6,500 lb. At present we are making about 4,300 lb. per 24 hr. By expending $500 for enlarged facilities for cooling and suitable apparatus for breaking up the thicker cake, the plant could easily turn out six tons of alum per 24 hr., though to do so would require additional labor and increase the cost about $1 per ton. A coil of lead pipe in the cooling tank through which cold water would flow would produce the desired result at less cost than duplicating the tank.

It will be noticed that the life of the plant has been assumed as 15 yr. Perhaps this may be high. If it be taken at 10 yr., the fixed charges would be $1.30 per ton, or an increase of 30c. If the life be further shortened to 5 yr., the fixed charges would be $2.23 per ton, or $1.25 more per ton than at 15-yr. life.

Swimming Pool on Top Floor of Old Club Building

Building a large swimming pool (with a load of about 400 tons of water) on top of an old building was an interesting part of the enlargement of the eight-story Union League Club Building in Chicago. This work was described by Frank E. Brown in a paper read recently before the Western Society of Engineers. The building is about 100x149 ft. A swimming pool was desired, but there was no available space in the basement; therefore, three stories were added to the rear part of the building (100x49 ft.) to accommodate the pool and gymnasium.

The swimming pool is 30x60 ft., with a depth of 4 to 8½ ft. The old cast-iron columns could not carry much additional load, and replacing them with new steel columns was out of the question, especially as the old foundations were inadequate. They were strengthened, however, to carry the ninth floor. The tenth floor (swimming pool) and eleventh floor are carried independently by new steel columns located so as to clear the old foundations and not obstruct important rooms. This arrangement involved difficult work in cutting and reframing the structural work in the building.

The sides of the pool are formed by plate-girders about 11 ft. deep, and the bottom has 18-in. I-beams spaced 13 to 24 in. c. to c., with a ⅜-in. deck plate riveted to their top flanges and to continuous angles on the sides of the girders. Steel trusses in the tenth story support the upper walls, some of these trusses being cantilevered 7 to 10 ft. from the new columns to the walls.

The waterproofing of the swimming pool was a special problem. The original intention was to make the steel tank water-tight by calking and riveting, and to line this with membrane waterproofing, concrete and tile. Instead, a lead lining was used. The rivet heads on the girders were flattened to ½ in., and a 1½-in. coat of cement was put on with the cement gun. On this was applied the sheet lead, 4 lb. per sq.ft. (about $\frac{1}{16}$ in. thick), tacked at the joints to wood strips set in the cement. The joints were then soldered.

On the lead was placed membrane waterproofing, then 4-in. cement (with the cement gun) and finally the lining of ¼-in. tile set in cement mortar. The bottom was treated in the same way, but with less concrete, the total

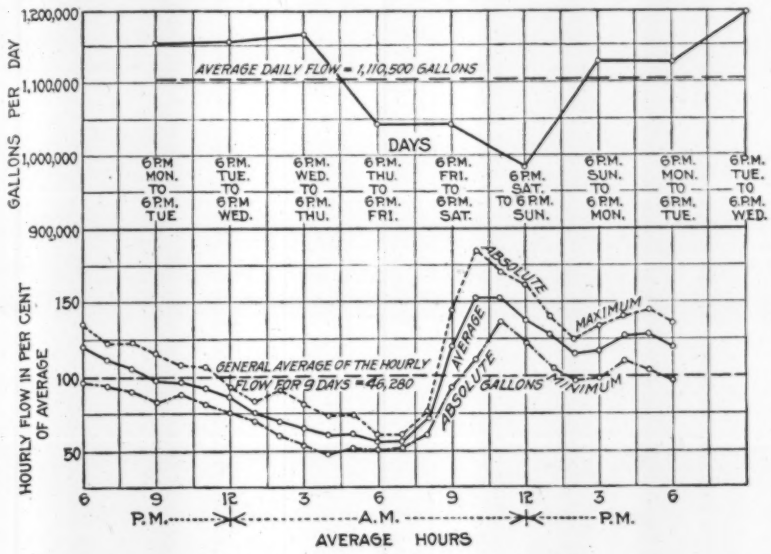
thickness of the lining being 7 in. for the sides and 4 in. for the bottom.

The water, after being treated with alum as a coagulant, passes through a quartz filter, a heater and then a violet-ray machine. The water is kept in continuous circulation and at uniform temperature. The tank is to be emptied and cleaned every two months.

Sewage Flow Measurements, Austin, Texas

By Julian Montgomery*

In 1914 the Texas legislature passed a stream-pollution bill that makes it necessary for the City of Austin and the State of Texas to treat properly the raw sewage coming from their mains before it is emptied into the Colorado River. As both mains empty into a common outfall, the cost of a system for the disposal of the combined sewage should be borne jointly by the state and the city. In order to arrive at a rational basis for prorating this cost and to obtain complete total volume-of-flow data for the purpose of design, measurements of the flow of the sewage were made by rectangular contracted weirs on both the state and the combined mains.


GALLONS PER DAY
1,200,000
1,100,000
1,000,000
900,000
AVERAGE DAILY FLOW = 1,110,500 GALLONS
DAYS
6 P.M. MON. TO 6 P.M. TUE.
6 P.M. TUE. TO 6 P.M. WED.
6 P.M. WED. TO 6 P.M. THU.
6 P.M. THU. TO 6 P.M. FRI.
6 P.M. FRI. TO 6 P.M. SAT.
6 P.M. SAT. TO 6 P.M. SUN.
6 P.M. SUN. TO 6 P.M. MON.
6 P.M. MON. TO 6 P.M. TUE.
6 P.M. TUE. TO 6 P.M. WED.
HOURLY FLOW IN PER CENT OF AVERAGE
150
100
50
ABSOLUTE MAXIMUM
AVERAGE
ABSOLUTE MINIMUM
GENERAL AVERAGE OF THE HOURLY FLOW FOR 9 DAYS = 46,280 GALLONS
6 9 12 3 6 9 12 3 6
P.M. A.M. P.M.
AVERAGE HOURS

SEWER GAGINGS AT AUSTIN, TEXAS

Not knowing the personnel of the legislative committee that will pass on the merits of the proposition to be submitted by the City of Austin, in which the State of Texas will be asked to pay a certain portion of the cost of the disposal plant, very elaborate data were collected for a rather lengthy period. It was decided to use Francis' formula in calculating the quantities of sewage. For an accurate application of the formula it was considered essential to observe every precaution, as did Francis in deriving his equations.

Hook gages were used to get the head on the weirs. Readings were taken every 15 min., day and night, for nine days. This gave a week cycle with an overlap of two days to care for any possible mishap. The men taking readings were made as comfortable as possible. Both lanterns and flash lights were used to take readings at night. In calculating the quantities of flow the average of the head raised to the 3/2 power for four 15-min. intervals was obtained, and this average $H^{\frac{3}{2}}$ was used in the formula $Q = 3.33(b - \frac{2}{10}H)H^{\frac{3}{2}}$ to obtain the quantity per hour.

It should be mentioned that the results were arrived at probably with more care and exactness than is usually thought necessary to observe for such measurements. The precautions imposed prior to and during the time at which readings were taken reduced to a minimum the percentage of error in the application of Francis' formula. Accepting the reliability of the formula, the small increment of time between readings of the hook gage gave an abundance of data that is an accurate index to the hourly, and consequently the daily, flow.

The accompanying curves were plotted from the combined sewage data. They may serve to give ideas of the variations of the hourly and daily flows at other cities. Of especial interest are the percentages of variation of the maximum and minimum hourly flows from the average hourly flow. It is seen that the variation of both the maximum and minimum from the average is about the same, being some 53%. A study of the average hourly-flow diagram shows that for about half of the day the flow is below the average, and above the average from 9 a.m. to 9 p.m. The rate of change is roughly a constant and always negative from 9 p.m. to 7 a.m., but the rate change for the period during which the flow is above the average is erratic. From 11 a.m. to 2 p.m. the rate of change is negative, from 2 p.m. to 5 p.m. the rate of change is positive, and from 5 p.m. to 9 a.m. the rate of change is negative, being positive again from 7 a.m. to 10 a.m. and practically zero from 10 a.m. to 11 a.m. The absolute-maximum and the absolute-minimum curves shown were plotted from the maximum and minimum hourly flows that occurred for each particular hour of the day during the nine days that readings were taken.

The measurements were made from the office of M. C. Welborn, city engineer. The writer had direct charge both of the field and office work. Engineering students from the University of Texas were employed to read the hook gages and aid in the numerous calculations.

*Assistant City Engineer, Austin, Tex.

Electricity for House Heating has been studied for several years by the Seattle Municipal Lighting Department, and enough data have been accumulated to afford some general conclusions. Eight different homes were equipped in various ways. Need of heat storage was shown (for the heating peaks came at 6:30 to 8 a.m. and 5 to 10 p.m.), until the heating load outgrows the lighting. But about ten times as much current is demanded for heating as for lighting a dwelling, so that when one house in ten is electrically heated the load-curve valleys will be filled and no more off-peak energy will be available. Where electric house heating is to be undertaken on any considerable scale, very cheap current is required. For the Seattle climate, electric house heating is 25 to 50% more expensive than coal—with current at 1c. per kw.-hr., coal of 1,000 B.t.u. per lb. at $6 per ton, and a 40% furnace efficiency.

Adding 11 Ft. to Top of Trap-Falls Dam at Bridgeport

By Charles A. Hirschberg*

SYNOPSIS—Increasing water-supply needs required enlargement of reservoir at Bridgeport, Conn. Mass-concrete dam 49 ft. high raised to 60 ft. and lengthened from 835 ft. to 1090 ft. by adding mass concrete on top and strengthening downstream face by buttresses and earth-fill. Details of construction, particularly the methods of bonding the old concrete to the new.

The growth of the City of Bridgeport, Conn., both commercially and in point of population, has been very marked during the past five years. In anticipation of

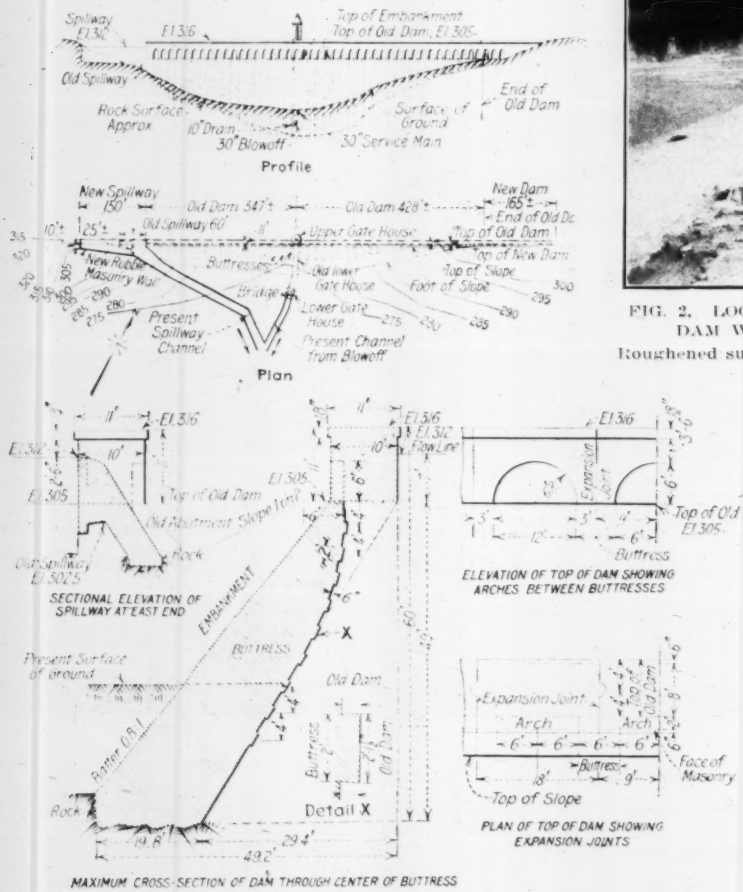

Profile
Plan
SECTIONAL ELEVATION OF SPILLWAY AT EAST END
ELEVATION OF TOP OF DAM SHOWING ARCHES BETWEEN BUTTRESSES
PLAN OF TOP OF DAM SHOWING EXPANSION JOINTS
MAXIMUM CROSS-SECTION OF DAM THROUGH CENTER OF BUTTRESS
Detail X

FIG. 1. DETAILS OF ENLARGEMENT OF TRAP FALLS DAM AT BRIDGEPORT, CONN.

a continuance of this growth the Bridgeport Hydraulic Co., which supplies the city with its water, has had under way various plans for an increased water-supply. One of the most important of these plans has been the Trap Falls Reservoir enlargement.

The Trap Falls Reservoir lies in a natural basin approximately 8 mi. above the City of Bridgeport and before reconstruction covered an area of about 240 acres of ground, closed at its outlet by a concrete dam of mass-structure built 11 years ago. The water is piped to the reservoir through 3 mi. of 30-in. mains from the Fa

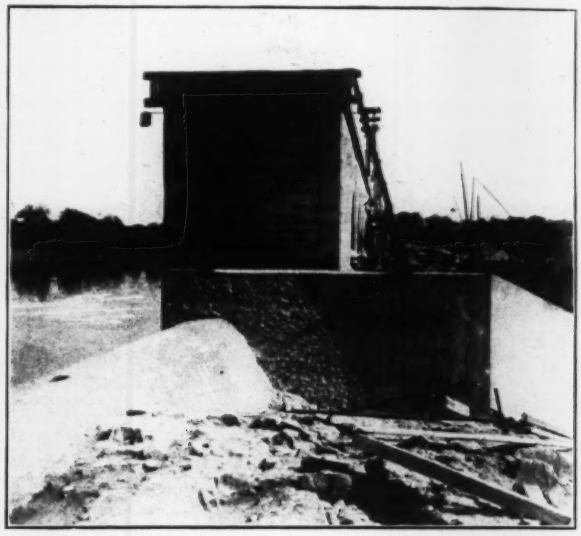


FIG. 2. LOOKING TOWARD ENLARGED SECTION MAIN DAM WITH OLD SPILLWAY IN FOREGROUND

Roughened surface indicates where new spillway section goes

Mills River, which has a drainage area of about 7 sq.mi. and through 4 mi. of 36-in. pipe from Means Brook, with a drainage area of 8 sq.mi. The capacity of the reservoir before reconstruction was 1400 million gallons of water—over 50% below the capacity for supply of the drainage area. The problem, therefore, involved the provision for larger storage capacity. To avoid extended shutdown of the water-supply from this reservoir, the Bridgeport Hydraulic Co.'s engineers decided upon the reconstruction of the old dam, in accordance with the plan shown in Fig. 1. It is interesting to mention that work progressed without in any way interfering with the water-supply except for a period of one week during the placing of the concrete buttresses in the vicinity of the service main. A comparison of the old and new dam structures (Fig. 2) shows an increase in height of 11 ft. and an increased length of 225 ft. The acreage of the reservoir is enlarged to 300 acres, and it will have a capacity for 2200 million gallons of water. The changes in the dimensions of the dam are given in the following table:

	Length Exclusive of Spillway, Ft.	Length of Spillway, Ft.	Total Length, Ft.	Maximum Height, Ft.	Width at Bottom, Ft.	Width at Top, Ft.
Old	775	60	835	49	29.4	8
New	940	150	1,090	60	49.2*	10

* Over buttress.

*Ingersoll-Rand Co., 11 Broadway, New York City.

The old structure was of mass concrete, and no provision whatever had been made for expansion; as a result the dam developed cracks with slight leaks. In the reconstruction, expansion has been provided for in a unique manner. Blocks of concrete 11 ft. high, 18 ft. long and 10 ft. wide were placed alternately 18 ft. apart on the top of the old dam and permitted to harden thoroughly before the intermediate blocks were poured. These blocks were joined to the old structure by means of a channel or keyway 18 in. wide and 4 in. deep, cut along the full length of the top of the old dam.

The increase in height made it desirable to brace the structure to take care of increased stresses. For this purpose 46 buttresses, as shown in Figs. 1 and 3, were provided. They are 6 ft. wide, placed on 18-ft. centers

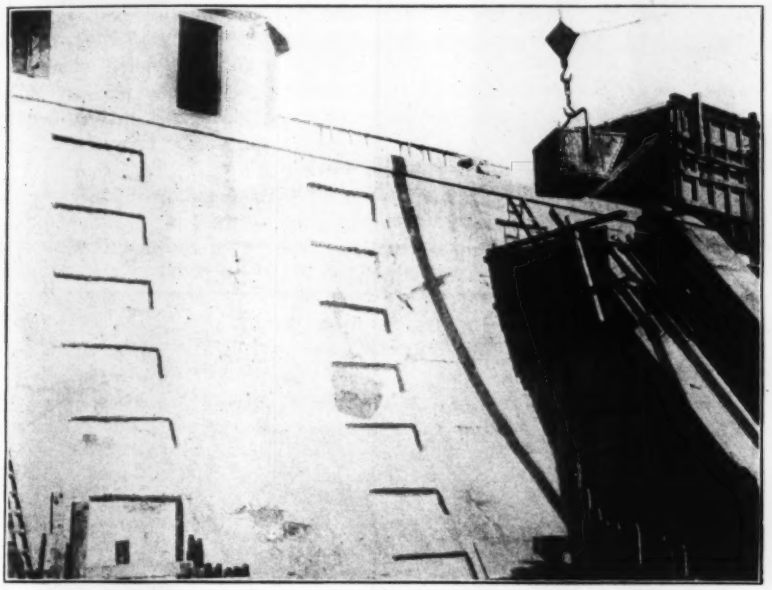


FIG. 3. MORTISES IN FACE TO TAKE NEW BUTTRESSES

and connected at the top by fascia arches, which also support the overhang of the concrete blocks placed at the top of the dam. The buttresses are filled in between with earth.

The greatest problem presented in this work was perhaps that of tying the new additions to the old structure. In Figs. 1 and 3 is shown the method adopted to key the buttresses. In order that these buttresses could take the thrust, mortise and tenon joints 6 ft. long by 2 ft. wide and 6 in. deep were made, 4 ft. 6 in. apart on a vertical plane in the face of the dam.

Methods of Cutting Mortises and Channel

The channel in the top of the dam and the mortises in the face were cut by drilling, broaching and picking, employing three "Jackhamer" drills and three "Little David" pneumatic picks. Holes were drilled with a 1½-in crossbit, approximately 1 in. apart both along and across the channel, to a depth of 4 in. This was followed by the pneumatic picks employing a special broaching tool, as shown in Fig. 4, along the outside edge of the channel, breaking down the intervening concrete to form a continuous groove. An ordinary pointed pick was then inserted in the pneumatic hammer and the drilled concrete chipped out.

In making the mortises for the buttresses, holes 6 in. deep were drilled with Jackhamers, as closely together as

FIG. 4. DETAIL OF BROACHING TOOL

they could be placed, with a 1½-in. crossbit. The men operating these drills worked from suspended platforms, and the drills were supported in special hangers suspended from 2½-in. air pipes strung along the face of the dam. The concrete between holes along the edge of the intended mortise was then broached by the flat tool already referred to, and the remaining concrete picked out by the pointed pick operated by a pneumatic hammer. One man and a Jackhamer drilled and broached one complete mortise in 4½ hr., and one man with a pneumatic pick averaged one mortise completely chipped out in a similar length of time. These tools were also used for drilling concrete form anchor-bolt holes to a depth of 6 in. All steel was sharpened by hand, a total of 60 pieces of 12-in. lengths being required for the job, which comprised 213 mortises, 775 ft. of channel and more than 500 six-inch anchor-bolt holes. To obtain a suitable rock footing for the buttresses, the overburden at the base of the dam was removed with pick and shovel. Where the natural contour of the rock did not provide a satisfactory footing, holes were drilled and blasted, the object being to obtain a saw-toothed surface.

Collapsible wooden forms were used for all concreting. Forms for the buttresses were shifted by stages toward the top, each pouring of concrete being permitted to set sufficiently before shifting the form. For keying each successive pouring of concrete, large pieces of rock were embedded in the concrete at the finish of each pouring.

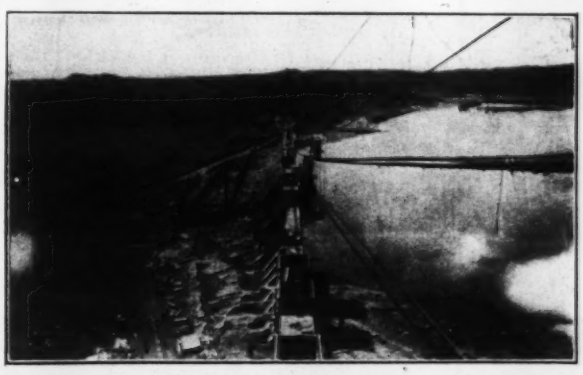


FIG. 5. LOOKING OVER TRAP FALLS DAM DURING RECONSTRUCTION

Each partially set batch of concrete was thoroughly wetted down before the next pouring.

For shifting the concrete forms, handling the rock and overburden at the base of each buttress, and also for dirt filling between buttresses, a Lidgerwood traveling derrick was employed. The object of the dirt filling

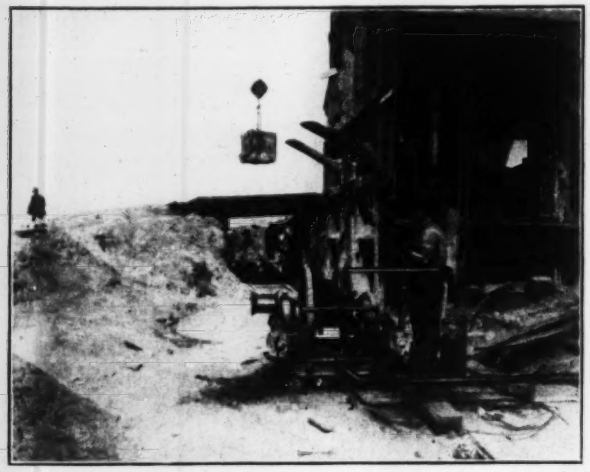


FIG. 6. AT BASE OF CONCRETE MIXER

is not only to lend additional support to the concrete structure, but to eliminate opportunity for freezing and spalling during cold weather. The concrete plant comprised two 1-cu.yd. steam-engine driven Ransome concrete mixers located at the western end of the work. All materials were supplied to the mixer at the top by means of a boom derrick and clam-shell bucket. A unique feature of this portion of the installation is the manner in which the concrete was conveyed to the Lidgerwood cableway that served the dam. Fig. 5 is a general view overlooking the dam, taken from one of the cableway towers. A small steam-operated winch carrying an endless cable hauled a flat-car back and forth on a track placed at right angles with the cableway and parallel with the concrete-mixer dumping chutes. Hand-operated square dumping buckets were placed on this flat-car and run in under the chutes. One was filled and returned to the dam, where the cableway traveler picked it up and conveyed it to the point of deposit. In the meantime the other bucket was being filled (Fig. 6).

The concrete mixture was 1:2½:4½ for the top and 1:3:5 for the buttresses. About 8,000 cu.yd. of concrete was required. All materials for the concrete were hauled in by four 5-ton Locomobile trucks. Two of these trucks were equipped with power self-dumping bodies, the other two with plain hinged bodies, which were dumped by means of the derrick serving the mixers.

The company operates its own trap-rock quarry, situated about 2 mi. from the dam. The trap rock, which is of a particularly hard, stubborn nature, full of cleavages and therefore presenting unusually difficult drilling, is excavated by means of three D21 Sergeant steam drills. The average drill-hole footage is low and gives a fairly good idea of the character of the rock—12 ft. per day per drill operated by two men.

A No. 5 McCully gyratory crusher installed at the quarry crushed all the rock, the straight run-of-crusher material larger than ⅜ in. being used in the mixers; none of it, however, ran larger than 2½ in. Sand was hauled to the dam a distance of approximately 1½ mi. For dumping the concrete in the buttress forms a portable inclined V-chute was employed, as shown in Fig. 4.

All machinery was steam operated, excepting the hammer drills at the dam, a 125-hp. boiler supplying all the necessary steam. All the machinery had seen service on numerous undertakings of the company, some of it having been purchased as long ago as five years before.

Work was started Aug. 1 and completed about the first of this year, an average of 100 men per day being employed. Considerable preparatory work had to be done before actual work began at the dam. It was necessary to build new and higher roads to replace those which would become inundated by the enlarged reservoir, to say nothing of the grading of certain portions of the reservoir banks and the clearing of the new land.

FIG. 7. NEW FACE OF RAISED TRAP FALLS DAM FOR BRIDGEPORT HYDRAULIC CO.

The work was done by the Bridgeport Hydraulic Co., under the supervision of its own engineers. S. P. Senior, Vice-President of the company, is Chief Engineer; W. C. Pollitt is Engineer-in-Charge of the work; and A. B. Hill, Consulting Engineer.

A Government Railway in the United States is a 23½-mi. line from Yuma, Ariz., to the Mexican boundary. The United States Reclamation Service has built a levee to protect land in the Yuma Valley from the annual overflow of the Colorado River. This was first protected against erosion by spur dikes and brush mats, but rock revetment became necessary and this could be placed economically only by a railway upon the levee. As local railway and other interests would not take the matter up, in view of the improbability of such a line being a financial success, the line was built by the Reclamation Service in 1914. Over 300,000 tons of rock have been handled and placed. Regular passenger service is maintained by a McKeen gasoline motor-car having seats for 70 passengers.

Rebuilding with Permanent Surface Old Macadam Roadways

Second-Prize Road-Building Article in the "Engineering News" Prize Contest

By Theron M. Ripley*

The writer assumes that a "permanent surface" which can be built and maintained indefinitely is one the minimum cost of which is its reconstruction cost plus the annual maintenance cost capitalized at the rate for which the builder can borrow, say 4%.

Heavy traffic within or adjacent to a city of 30,000 population would not be heavy traffic for a similar location to a city of 300,000 or 3,000,000 population. If "heavy" refers to a dense traffic of light vehicles, the problem is different from a traffic, of any density, consisting of heavy vehicles. In the past macadam roads have been constructed where, today, traffic of both varieties obtains.

For roads of dense light-vehicle traffic—namely, ordinary farm and automobile traffic—where a foundation course of telford yet remains, a permanent top can be constructed of either bituminous macadam or concrete, depending upon the cost of construction and maintenance. Frequently this latter cost is indeterminate except within relatively wide limits. The estimated cost of reconstruction, for purposes of comparison in the determination of type, can readily be obtained.

For the great majority of roads, outside of business districts, where funds are limited, we are confined to three types—cement-concrete, mixed-bituminous and penetration-bituminous tops. This limit is due to the fact that the excess first cost of block pavements in all but favored localities is greater than the first cost of any one of the three types mentioned plus their maintenance cost, capitalized. This limit, moreover, brings us into the cheaper types and, consequently, more easily within the limit of the "money available."

For residential streets in cities and villages the mixed-bituminous tops should be given careful consideration for reasons of color, noise and slipperiness. For a suburban and rural traffic that has developed beyond the waterbound-macadam stage, but is not and may never be a mill, mining or heavy commercial traffic we are practically confined to two types—concrete and penetration bituminous.

Save the Telford Foundation

The premises of this article presuppose "often on a solid telford foundation." If it is not solid, the problem receives a new equation; namely, is it solid enough for concrete, if not for bituminous macadam? The limits of this paper will not permit discussing this equation; we must assume that the foundation is solid.

In no instance should the old telford base be removed unless conditions aside from those of actual resurfacing require it. Use the old top for reshaping the telford or repairing shoulders. The old foundation should be subdrained with tile or blind drains or both, keeping the tile at least 18 in. deep and carefully backfilling the trenches with broken stone, using the blind drains as feeders to the tile. The lateral ditches in clay and heavy loam should be at least 2 ft. below the crown of the road.

It must be constantly borne in mind that *no* surface will withstand heaving by frost action or settling under traffic into a quagmire. If there is a subsurface flow across the road, particularly in heavy soils, a tile drain in the shoulder or ditch is a necessity. Use 6-in. vitrified tile with joints wrapped in burlap and have outlets every 250 ft., if possible. The "lay of the land" must determine the details. Never forget the lateral, or cross, drains in any soil containing clay.

Comparative Costs

For comparison of cost, to determine the type, three roads built under the writer's supervision will be used. The cement-concrete resurfacing (built in 1914) was tile drained and cost $1.216 per sq.yd., including the repair of shoulders and ditches. Two bituminous-penetration jobs (built in 1914 and 1916), similarly subdrained, reditched, etc., cost 71.7c. per sq.yd. The pavement in each instance is 14 ft. wide. These costs give $1.216 — $0.717 = 49.9c. per sq.yd. in favor of the bituminous penetration, which multiplied by 4% gives 1.996c., which can be used for maintenance.

The maintenance cost of the cement concrete has been 1.166c. per sq.yd.; that of the bituminous road (no costs on 1916 roads) has been 5.266c. per sq.yd. Therefore, 5.266 — 1.166 = 4.1c., and 4.1 — 1.996 = 2.104c. in favor of the concrete road. This 2.104c. capitalized at 4% = 52.6c. per sq.yd., equal to $1,320.04 per mi. of 14-ft. pavement, which of course represents the allowable additional investment in a concrete over a bituminous penetration pavement. The pavement in each of the above cases was built upon the old road foundation.

"There is generally need for widening the old roadway." Place more telford on one or both sides of the old foundation, rolling the entire width of both so as to have a uniform bearing for the top. Shape the foundation practically the same as the finished top for bituminous macadam (crown $\frac{3}{8}$ in. per foot of half width), and make it level for concrete. Do this by building up on the sides. Do not remove the old foundation, if possible to avoid it.

Material excavated can be used for widening and raising the shoulders or widening a near-by fill. A 16-ft. paved roadway with 7-ft. shoulders of good bearing material will care for an immense amount of light traffic, but with heavy truck traffic a three-track surface of 22 or 24 ft. is required.

Whether 100 or 1,000 vehicles per day use a properly constructed bituminous or concrete top will make little difference in its maintenance so long as they do not break its surface, but one good hard winter with its accompanying spring break-up will make an undrained road, no matter how hard its top, look like a badly ploughed field.

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The Miami Valley Flood-Protection Work

II—Why Retarding Basins Were Adopted

Development of Miami Protection Plans; Retarding Basins the Only Solution; How Basin and Channel Work was Balanced; A Statement of the Factors That Favor Retarding Basins in the Miami Valley

The nine judges of the Miami Conservancy Court declared unanimously, only a few weeks ago, that retarding basins are the best and only practicable method of flood protection for the Miami Valley. Their finding was a restatement of what the engineers had discovered nearly two years before.

The early investigation made by the Morgan Engineering Co. for the Dayton Flood Protection Committee, and later for a similar Miami Valley committee representing all parts of the river basin, was begun frankly on a channel-improvement basis. For the first month or two the problem assigned was primarily to find a means of protecting Dayton and incidentally to learn whether the problem was a local one or must concern the entire valley. Very soon the whole valley was made the primary objective, as it became recognized that success could come only through coöperation.

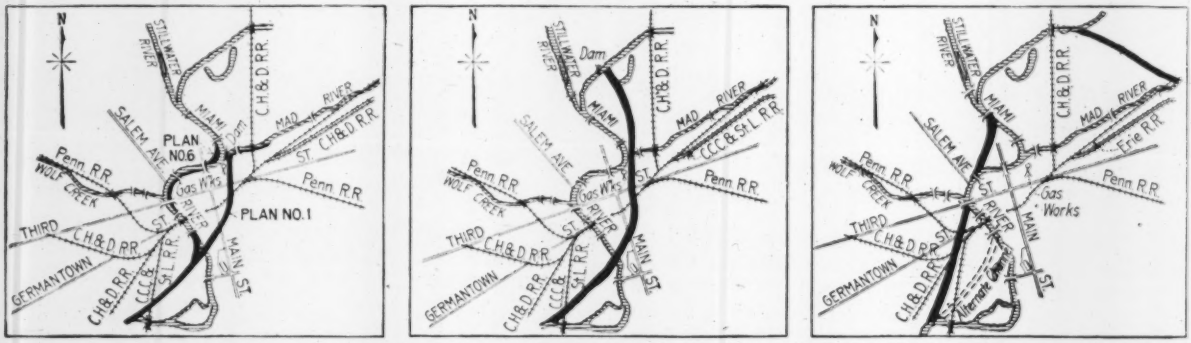


FIG. 1. SKETCHES OF SOME EARLY FLOOD PROTECTION SCHEMES FOR DAYTON

One-channel improvement and three diversion plans: Plan 1, at left, diversion of the Mad River by a dam at its mouth through a channel along the Miami and Erie Canal, in conjunction with two storage reservoirs on the Stillwater; Plan 2, in middle, has the same reservoirs, but a joint diversion of both Miami and Mad Rivers along the canal location; Plan 3, at right, diversion of Mad River into the Miami, with a west-side cutoff to carry the three rivers; Plan 6, at left, channel improvement through the main part of the city

Construction of bypasses or cutoffs, widening and deepening of the river, levee raising, diversion of one or another branch of the river into a neighboring drainage area—these and all other possible schemes for dealing with Miami floods were studied. Definite cost estimates were made for most of them. The sketch plans grouped in Fig. 1 outline several of the preliminary schemes for the Dayton protection. Similar ones, equally radical, were devised for a few other parts of the valley.

Full Trial of Bypass Projects

Two among the projected methods for protecting the City of Dayton are characteristic: The first had as its main feature a huge reinforced-concrete culvert through the city along the line of the old Miami & Erie Canal, on the east bank; the second involved open bypasses on the west bank. It was found possible to put the east-side box culvert through the city at a cost of perhaps $15,000,000. The city would be cut apart by a 10-ft. wall. Auxiliary levees above and below the city would be required to confine the waters. The railway entrance to the city would be blocked, and the city would be confined within ramparts, throttling its development. The west-side bypass channel required excavation and the placing of concrete 30 ft. below groundwater for miles, through a densely settled district, and at best proportions it entailed water velocities up to 20 ft. per sec.

These two cases picture the general unpromising aspect of all the diversion schemes. Channel improvement showed up little better.

The five concrete bridges crossing the river within the city were a first obstacle. It would have cost $1,000,000 to raise them for a higher flood level, and a large additional amount to carry the piers down lower, for channel deepening. Probably tearing out the old bridges and building new ones would have been the best course. However, this was the least of the difficulties encountered.

By widening the river through high-priced property, as much as possible; deepening its channel 10 ft.; paving the bottom to withstand high velocities; and, in some of the variations, raising the existing levees by amounts of 3 to 5 ft., the 1913 flood flow could be carried through the city. How the water could be cared for at the sloping drop (or dam) required at the upper end of the city to deliver the flow safely to the improved channel remained a problem.

At the most moderate estimate the cost of the whole work would run up to $16,000,000 or $20,000,000. This would protect Dayton alone. A large annual maintenance expense had to be faced in addition. A further complication of the case appeared at this time. Computations of the amount of water stored in the overflow portions of the valley during the 1913 flood showed that this storage was of enormous amount. With full-capacity channels, giving a more rapid flood wave by eliminating the valley storage, the greatest flow at Dayton would be raised from 250,000 to 300,000 sec.-ft., and at Hamilton from 350,000

to 500,000 sec.-ft. The increased figures made the problem virtually impossible.

From the first, attention had been given simultaneously to all possible means of protection. The survey parties reconnoitered for reservoir basins and dam sites, while they were taking flood levels, topography, river slopes and geological memoranda. Elaborate studies of what reservoir control has accomplished in other parts of the world were started in the summer of 1913. Control by "dry reservoirs"—retarding basins—was suggested at the same time. Data were being accumulated that placed increasing emphasis on storage or detention possibilities.

Investigation of Basins For Flood Reduction

The ultimate result of the work, by the end of 1913, was that local protection—by channel improvement, by bypasses, by levees—had demonstrated its impracticability. Basin-storage projects were now outlined and studied, though at first with not much faith. Very shortly the planning was centered on dry basins, as giving obviously the maximum flood reduction. Further steps in the progress of thought soon introduced the idea of minimum-time detention—that is, making the permanent outlets of the basins just as large as the channels below could be adapted to. The three advantages secured by quick emptying of the basins were (1) that the farm lands in the basins would remain wet the shortest time; (2) that the basins would quickly be ready for new service in the improbable case of a second storm coming soon after; and (3) that during the early part of the storm the capacity of the basin was being held empty and available for storing the crest of the flood.

The unpromising flat valley of the Miami and its tributaries was found to possess excellent basin locations, with dam sites permitting the construction of moderate-cost dams and affording enormous volumes of storage. These sites were studied in detail. Many reservoirs were laid out, their influence on flood flow was studied, and various combinations were made.

It was then found that the available reservoir storage was large enough, and sufficiently well distributed, to enable complete flood control to be obtained for the valley as a whole. Several possible combinations of reservoirs, supplemented by moderate channel improvement to carry their discharge, were found to cost less than the Dayton local protection by channel enlargement.

This discovery focused all further work on control by retarding basins. The best basin combination was worked out, and trial estimates of various amounts of channel improvement were made, to balance against the cost of increased reservoir capacity, in order to arrive at the final project. Results in substantially their present form were reached by the beginning of 1915.

In the meantime the state legislature had passed the act allowing conservancy districts to be formed, so that the machinery for joint action of the valley was available. The clinching argument for joint action lay in the fact, shown by the full estimate of cost, that no part of the valley could provide for itself alone at less cost than its share of cost of the general project, or at as low a cost.

Five retarding basins were embraced in the scheme, as the map, Fig. 2, exhibits. Three lie just above Dayton, in the three main streams that join within the city—the Taylorsville basin on the Miami, the Huffman basin on the Mad River and the Englewood basin on the Stillwater.

TABLE 1. DATA OF THE RETARDING BASINS

Basins	Dam Height, Ft.	Dam Length, Ft.	Drainage Area, Sq. Mi.	Spillway, Elevation	Water Surface at Spillway, Acres	Capacity at Spillway Inches of Runoff on Drainage Area Acre-Feet	Capacity at Spillway Inches of Runoff on Drainage Area Instantaneous	Three-Day Filling with Outlets Discharging
Germantown	107	1,210	270	815	3,520	106,000	7 30	10 75
Englewood	124	4,660	651	876	7,930	112,000	8 99	10 70
Lockington	78	6,400	255	938	4,020	70,000	6 68	10 00
Taylorsville	78	2,980	1,133	818	11,000	186,000	4 42	9 51
Huffman	73	3,340	671	835	9,180	167,000	4 66	9 52
					35,650	841,000		

These throttle the extreme concentration that takes place here at the base of the main fan of the valley. Of the other two, the Lockington reservoir controls the upper Miami and thereby protects the cities of Piqua and Troy, while the Germantown basin, on Twin Creek, reduces an important flood contribution to the Middletown flow.

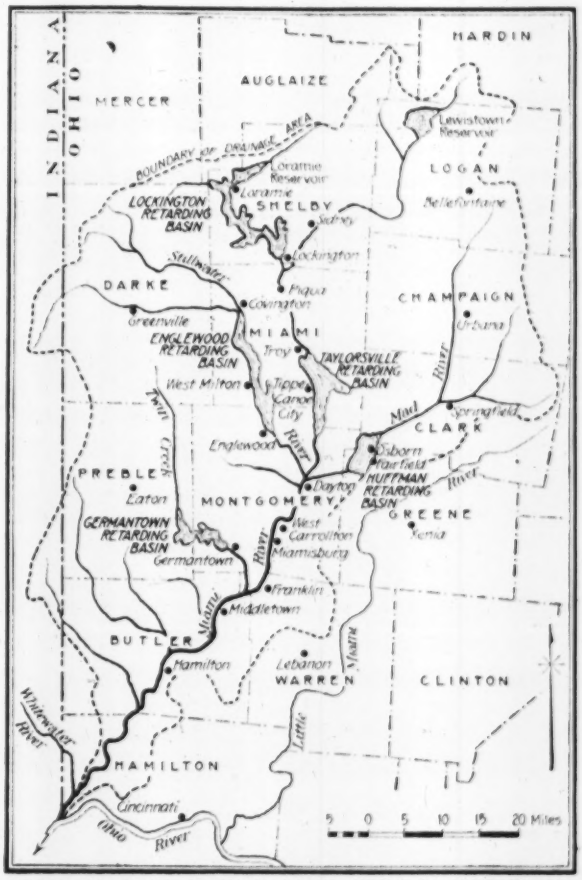


FIG. 2. MAP OF MIAMI VALLEY, WITH LOCATIONS OF THE FIVE RETARDING BASINS TO BE BUILT

Table 1 gives numerical data on the basins and their dams. Each dam is pierced by two to four large conduits, permanently open, located at the base of the dam. These are to pass the normal river flow, and in floods are to discharge water under head. No gates, stoplog notches or other closure devices are fitted. The entrance is protected from drift by piers and a floating boom.

Enormous volumes of water will be discharged from the conduits at maximum flood. It should be remarked that the conduits are so proportioned in relation to drainage area and basin capacity as to let the basins fill approximately to spillway level in the assumed ultimate maximum flood. Spillways are provided, with 15-ft. to 19-ft. freeboard below dam crest, as a pure safety margin, which

amounts to about 40% over the maximum flood. In case of a flood twice as great as that of 1913 the dams would have a freeboard of 5 ft. The insurance of this freeboard in such a case finally determined the heights of the dams. The Germantown, Englewood and Lockington dams required a greater freeboard than 15 ft. above the spillway to meet the second condition.

Table 2 gives the conduit discharges in second-feet for the ultimate maximum storm, when the basins are filled to spillway level. These discharges involve velocities of flow amounting to over 55 ft. per sec. at several of the dams.

TABLE 2. CONDUIT DISCHARGES FROM THE BASINS WHEN FULL TO THE SPILLWAYS

Basin	Discharge Sec.-Ft.
Germantown	10,000
Englewood	12,000
Lockington	8,830
Taylorsville	536,00
Huffman	35,000

Balancing Basin and Channel Work

The most desirable combination of basins and channel improvement would be that one costing the least to build. This balance could be attained in the Franklin County Conservancy project (Columbus, Ohio). In the Miami project it is nearly attained, but not quite. The limiting factors were certain conditions affecting the basin storage.

To develop the ideal capacity of the Taylorsville basin would submerge much of Tippecanoe City, a village some five miles above the dam. Troy, lying several miles farther north, would possibly also be affected. Similar conditions apply to the Huffman basin, where the cost of more radical railway readjustments would be prohibitive.

In consequence these two basins are of smaller capacity than the others, relative to their position and drainage area. The result is seen (Table 2) in the large discharge rates of 55,000 and 35,000 sec.-ft. for the two basins when full to spillway. The sum of these two figures alone gives a flood flow equal to the entire present capacity of the Miami River Channel at Dayton.

With respect to the other basins, it may be said generally that larger capacity could have been secured without difficulty. The additional benefit would be small, however. The Englewood basin already has a capacity so large that three weeks will be required to empty it after the maximum storm. This basin, by the way, supplements Huffman and Taylorsville in vital manner, because it reduces the Stillwater's contribution to flow at Dayton from 88,000 to 12,000 sec.-ft. The Germantown basin will not economically bear much enlargement, because the flow is already reduced from 66,000 sec.-ft., in the case of the 1913 flood, to 9000 sec.ft.

In spite of these modifying factors it may be put as an approximate fact that just so much channel work is to be done and basins of such size provided, that the total cost of the whole enterprise is a minimum, while securing full protection to the entire valley in all great storms.

The cost figures are briefly summarized in Table 3. Of the figure for channel work and local protection, only a little over $2,000,000 represents cost of channel enlargement, or work that might be saved by increasing the storage. Against this stands the figure of $5,000,000 as the cost of increasing the storage by any material amount.

TABLE 3. COST OF MAIN ITEMS OF THE MIAMI WORK

Retarding basins, not including real estate	$6,735,000
Real estate in retarding basins	3,500,000
Channel work and local protection	3,468,000
Real estate other than in basins	2,200,000
Public utilities, relocations and damages	2,307,000
Total, not including interest, taxes, administration and contingencies	$18,210,000

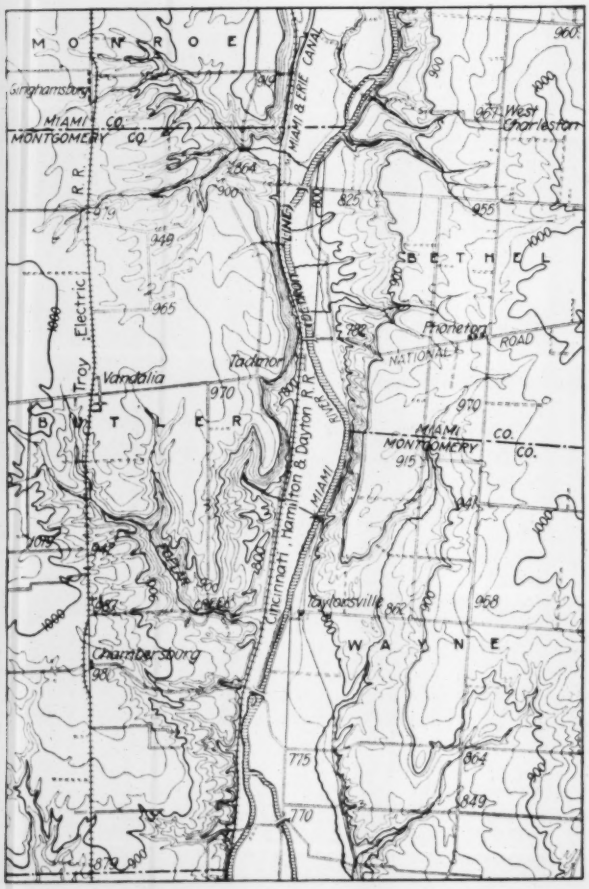


FIG. 3. CHARACTERISTIC TOPOGRAPHY OF MIAMI VALLEY, AS SHOWN BY MAP OF TAYLORSVILLE REGION

Factors Favoring Retarding Basins in the Miami Valley

The great novelty of the Miami project invites attention to the special features contributing toward the easy superiority of retarding-basin control in this valley. An inquiry indicates the following points as bearing on the question:

The River Is Flashy—A remarkably high ratio of maximum to minimum flow is found in the Miami, about 1000. Floods are not only large, but sudden. The river is characterized by two-day to three-day floods, with flows of 100 sec.-ft. per sq.mi. The Seine at Paris, which is not without serious floods, carries at the maximum 87,000 sec.-ft., from a drainage area of 17,000 sq.mi.; its floods last a month or two. The Miami, at Dayton, with one-seventh as large a drainage area, has floods three times as great, which are over in four or five days. The valley has a high concentration rate, due to its highly fan-shaped arrangement and to its straight supply channels.

Retarding basins are concerned primarily with the aggregate discharge; hence slow, long-continued floods preclude their use. Channel improvements have to deal with *maximum rate* of discharge, irrespective of aggregate discharge; hence channel improvement is the more difficult the more flashy the stream. The latter consideration

applies with special force when the greatest floods are to be provided for, as was desired in the Miami.

Good Basins—The region is flat, and to the eye appears devoid of reservoir possibilities. Yet its valleys are wide but well-defined steep-sided grooves in the upland. They have a flat longitudinal slope and a level floor transversely. Thus they are capable of providing very large storage volumes, if a dam site can be found. The topography is represented characteristically by the map, Fig. 3, at the Taylorsville dam.

Ample Storage Capacity—The storage capacity that can be developed is not so closely limited as to be adapted only by lucky chance to the ultimate maximum flood flow. Arthur E. Morgan, Chief Engineer, expresses the view that if the flood runoff to be protected against were as great as 20 in., in place of 10 in., yet retarding-basin control would still be the principal hope (or better, the only hope).

It is important to observe that villages are rather thinly scattered in the valley. Were there more frequent villages or towns, the development of adequate basins would involve considerably greater cost in the way of damages.

Many Dam Sites Available—Good dam sites exist (see Fig. 4); in fact, there are more than need be utilized. Due to the shape of the valley sections, moreover, the dams are cheap. Those actually designed cost $6 to $16 per acre-foot of storage capacity, or about $300 per million cubic feet on the average ($13 per acre-foot).

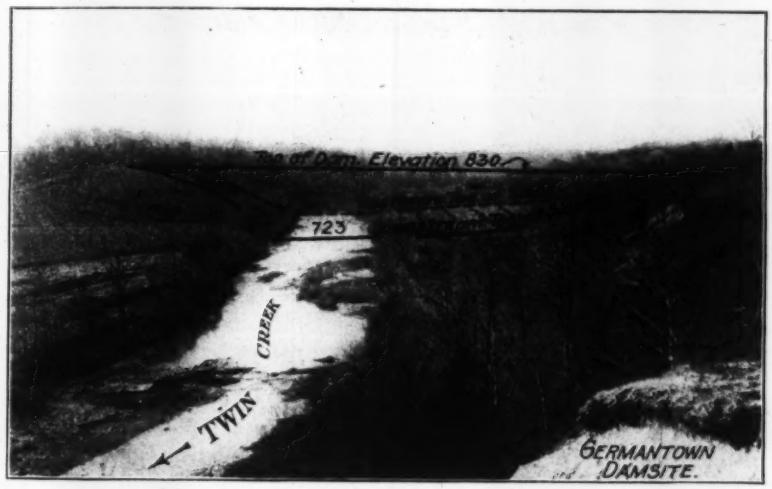


FIG. 4. GERMANTOWN DAM SITE, SHOWING VALLEY TOPOGRAPHY IN THE MIAMI AREA

The other dams are much longer, but abut against valley sides of similar form and character.

The Miami plan is unique in being a device for securing *complete* protection against the largest floods ever possible. In this respect as well as in the admirable way it was worked out, it stands as a model, and as an object for most careful study by future workers in flood protection. The fact that the valley is rather unusually well adapted to basin control is perhaps the chief or only natural condition that facilitated the engineers' planning. An ample supply of money for full investigation was the great outside advantage.

Arthur E. Morgan has been Chief Engineer of the project from its initiation; Daniel W. Mead, a member of the Board of Consulting Engineers, acted as Chief Engineer of the District during an illness of Mr. Morgan, and was frequently consulted during the preparation of the general plan, the working out of the details of construction, and the writing of the specifications; S. M. Woodward, Consulting Engineer, and Kenneth C. Grant were responsible for the hydraulic studies and calculations throughout the preparation of the plans; O. N. Floyd, engaged upon the project from its beginning, personally directed much of the field work, has kept in close touch with all the engineering details, and has been largely charged with the innumerable negotiations with public service companies during the development of the project. C. A. Bock has been Office Engineer during the preparation of the plans.

Tile Drainage in Wet Cuts

Vitrified tile has been used extensively on the Missouri Pacific System for draining water-pockets and wet cuts. Of 714 locations about 11% were reported as failures, due either to insufficient depth or improper installation. Investigations were made at various locations and the results are stated as follows by W. C. Curd, Drainage Engineer of the system, in Bulletin No. 189 of the American Railway Engineering Association:

The investigation showed a remarkable benefit to have been derived through the strengthening of roadbed where drains had been properly installed. Estimates indicate a return of 50 to 200% per year in the decreased cost of maintaining line and surface on the short pieces of track that were drained. The failures were found to be due principally to improper installation, particularly with reference to depth of drain to the moving material in the roadbed. The necessity for tiling cuts comes from neglect to provide and maintain adequate surface drainage. Just as efficient, if not better, track could be developed if cuts were protected by intercepting and side ditches properly constructed and maintained, but tile seems to afford the only practical relief where the roadbed has become water soaked and too soft to sustain the loads. Drains should be laid with bell-end vitrified salt-glazed sewer pipe of 6-in. minimum diameter, with unsealed joints. The top of tile should be 12 in. below frost line and a minimum distance of 12 in. below unstable or moving material. Tile should be laid to grade established by level, and with all the fall obtainable. The center line of tile should be parallel to and from 4½ to 7 ft. from center of track.

Tile should be placed directly on the bottom of the trench. After it is laid to line and grade, and before backfilling, it should be covered with straw, grass or some such material to prevent loose particles in backfilling from entering the joints. Trenches should be backfilled with cinders, coarse material being placed directly around and over the tile. Where the sides of the trench show signs of distortion from passing loads, a sufficient quantity of riprap or coarse stone should be mixed with the cinders to brace the walls.

Pockets under track should be tapped with cinder-filled lateral trenches, and connected with the tile-drain trench, but without connection with tile drain except through the unsealed joints. Remove all surface water from cuts by intercepting and side ditches; otherwise the tile drain may be overtaxed and eventually fail entirely.

After drains have been installed, it is essential to maintain free outlets to prevent backing water into the tile. The ends of drains should be surrounded and supported by concrete or dry masonry to guard against underwash. To prevent small animals from entering tile, the outlet should be protected by rods or grating. Failures of drains come from the following causes: Insufficient depth below moving material, shifting grade or alignment causing joints to open, insufficient grade to provide proper flow, location of drain in impervious material without providing adequate means for tapping saturated material with lateral drains or cross-trenches, distortion of walls of trenches.

Adding Three Stories to Engineering Societies' Building

SYNOPSIS—The decision of the American Society of Civil Engineers to join the other engineering societies in their headquarters building in New York City necessitated the enlargement of that building, a modern steel frame structure. Article gives in detail the structural work of adding three stories to a 12-story building.

Placed on steel stilts some 200 ft. high, the new superstructure of three stories which is being built on the Engineering Societies' building at 25 West 39th St., New York, to accommodate the American Society of Civil Engineers and to increase the library space by the addition of an entire stack floor, will be a structure of bold and novel character. The design represents the solution of a problem at first considered impossible. Both architecturally and structurally, the task of building the three additional stories over the present roof of the building offered the most serious difficulties.

The Architectural Problem and Its Solution

The top of the present building is occupied by the large joint library, housed in a hall spanned by trusses carrying the roof. The three-story addition is to be placed directly over the library, starting from the level of the present ceiling, just below the roof trusses. But the library is not the only large-span room in the building. The main auditorium on the third floor and several meeting rooms on the fifth and sixth floors interrupt the continuity of the column system and, with the library, stand in the way of providing direct support for ordinary beam framing in the new floors above.

The esthetic phase of the problem was very difficult. The exterior architecture of the old building was strictly proportioned to the original height and the development of its upper part appeared to preclude the possibility of building over it with satisfactory esthetic effect. After making numerous studies, however, it appeared that the very restrictions imposed by the structural conditions afforded a happy solution of the esthetic problem. The truss framing that had to be used to carry the new load made it virtually necessary to set back the walls of the added stories. This arrangement suggested a penthouse or tower effect, and on working this out in due proportion to the old building a satisfactory result was secured. The added mass does not weigh down the old cornice, and, it is believed by those directing the work, the effect is that of a building structurally and architecturally homogeneous.

Devising Means for Carrying the Superstructure

Because of the open spaces in the building, a wide-span construction was necessary. The walls and available columns of the building were incapable of carrying any considerable added load, however; and with respect to reinforcing the old columns there were such serious objections as to make this expedient very undesirable.

At first it seemed impossible to find locations for running up new columns without cutting into meeting rooms or otherwise injuriously affecting the occupancy or interior arrangement of the old building. Finally, however, a careful study of the floor plans showed that at four points near the corners of the existing auditorium it was possible to run up new columns passing everywhere through walls or partitions or through duct spaces. At two of these points, moreover, the new column would be close to an existing column to which it could be braced. This at once furnished the solution of the structural problem, the frame of the new superstructure being developed as a cage supported by a series of trusses resting on the four new columns except for a small amount of weight transferred to the old side walls. The project was worked through on this basis, and the contractor is now building it in accordance with this design.

The two floors of the old building which made the most difficulty with respect to column locations, the floors under and above the large auditorium, are shown in the plan, Fig. 1, and superimposed on this framing is shown the location of the new columns and the trusswork to be placed above the old roof. One of the new columns is set in a freight elevator, another in a flue, a third in a space that is partly stair well and partly duct space, and the fourth in a partition.

Two problems of detail in working out this scheme were, (1) provision of suitable foundations for the new columns, and (2) staying the columns laterally. How the foundation problem was worked out is shown by Fig. 4, which represents two of the new footings. The new columns in all cases come so near to old columns that the foundations partly coalesce. In one case the new column is provided for by adding an extension at one side of the old pier and thus making a composite foundation. In the other cases the new columns have footing piers on either side of the old foundation with girders on top of the new piers straddling the old foundations and designed to carry the new columns.

The columns are stayed against buckling by tie-connections either to adjoining columns or to floor beams. Fig. 5 shows typical connections of both kinds.

No New Bracing Provided

The new columns do not include any means of wind bracing. Therefore the wind pressure against the new superstructure will be transferred into the frame of the old building and be absorbed there. However, the old building contains no diagonal bracing, knee-brackets, or rigid beam-connections, but depends for lateral stiffness entirely on the resistance of the brick walls. With the structure as enlarged these brick walls will have to carry the additional lateral load that may come on the three new stories.

The original design of the building was made under the old New York City building code. The revision of this code, completed a year ago, permits greatly reduced thickness of outside walls in steel-frame buildings and makes other changes favorable to structural design. The old walls therefore have a large excess of strength, when judged by the new law, and the designers considered that some additional load could be placed on the walls.

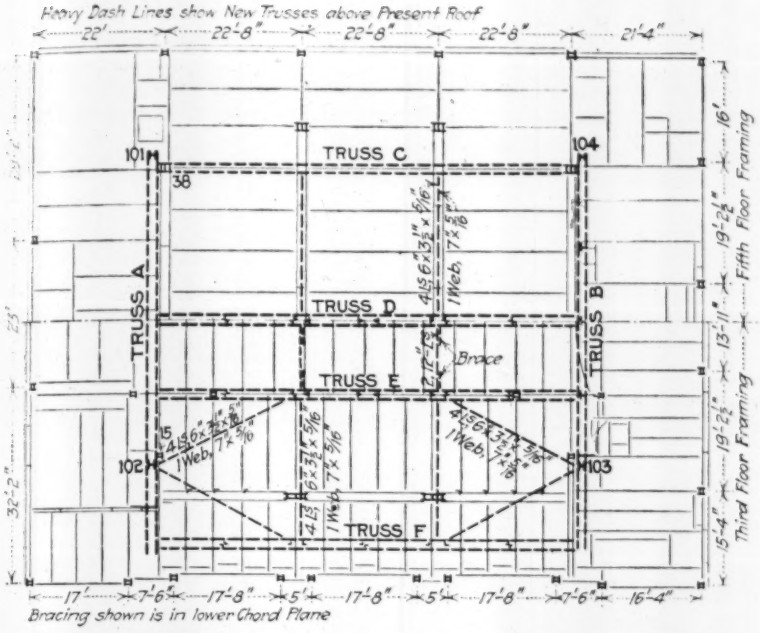
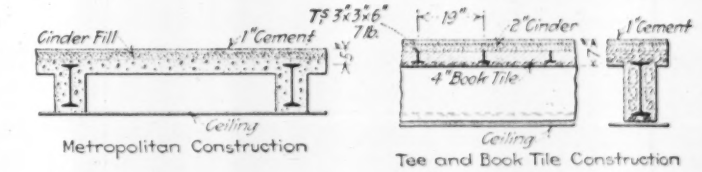


FIG. 1. POSITION OF NEW COLUMNS AND TRUSS SYSTEM (15TH FLOOR) WITH RESPECT TO OLD FRAMING (THIRD AND FIFTH FLOORS)

The outer bay of beams in the (new) 14th floor rests on top of the old wall. These beams carry not only their own floor and roof loads but also, at some points, the load of the outside columns in the 14th story, as can be seen from the plan Fig. 2. Along the west and north walls, moreover, the outer wall is continued up vertically, so that three added stories of wall and floor loads come on these walls. While the old wall is carried on a wall girder at each floor level, the added load is assumed to transmit down through the brickwork, without increasing the stress in the old wall girders. The wall is regarded as a bearing wall with respect to the added load, and as a curtain wall with respect to the original load. The structural arrangement of the new floors is simple except for the 14th floor, which is suspended from the trusses. This floor comes directly over the ceiling of the present library, and its construction was planned such as to create the least possible risk to the library from drip or falling material. Book tile 4 in. thick, to be covered by a cement floor, were therefore adopted; 3-in. tees 19 in. apart are provided to carry the book tile. The other floors are to be of Metropolitan type reinforced-concrete slab floor, which type was chosen for its light weight. Weight also dictated the design of the outside walls, which are to be 12 in. thick, comprising 8-in. hollow tile and 4 in. brick facing. The column loads of this new superstructure are large; Col. 101, 768,000 lb.; Col. 102, 1,494,000 lb.; Col. 103, 1,537,000 lb.; Col. 104, 878,000 lb. Drawings of the truss construction are shown by Fig. 3. Two main trusses run north and south cantilevering forward over the southerly pair of columns. Four east-west trusses frame into them. Provision for passageways through the trusses is made by short central panels without diagonals in the main trusses, and by a portal arrangement of the sway bracing between the middle transverse trusses. The trusses are below the 15th floor, and their bottom chords are at half-height of the 14th story. This story is to be used as a stack room of the library, and the bottom-chord level is at the intermediate platform level of the book stacks. Lateral bracing is placed at this level to stay the tops of the columns. A top-chord system of laterals is built into the framing of the 15th floor. The 14th floor is suspended from the trusses by hangers. Its beams come directly over the existing library ceiling, and are to be placed without disturbing the ceiling. The old roof trusses will be left in place until the new steelwork is erected and the ceiling beams hung to the beams of the 14th floor. The new work includes about 686 tons of steel.

Elevator service to the new floors will be obtained by extending the three present elevator shafts up to the new roof. Incidentally, new machines will be fitted, traction elevators replacing the present drum machines.

The work is in charge of a joint committee of the several societies. H. H. Barnes is chairman. Charles Warren Hunt represents the tenant of the new stories—



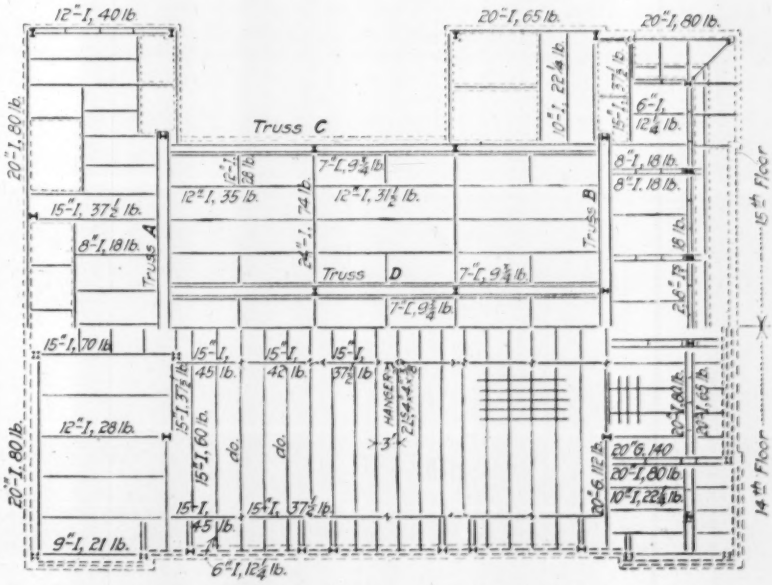


FIG. 2. PLANS OF 14TH AND 15TH FLOORS

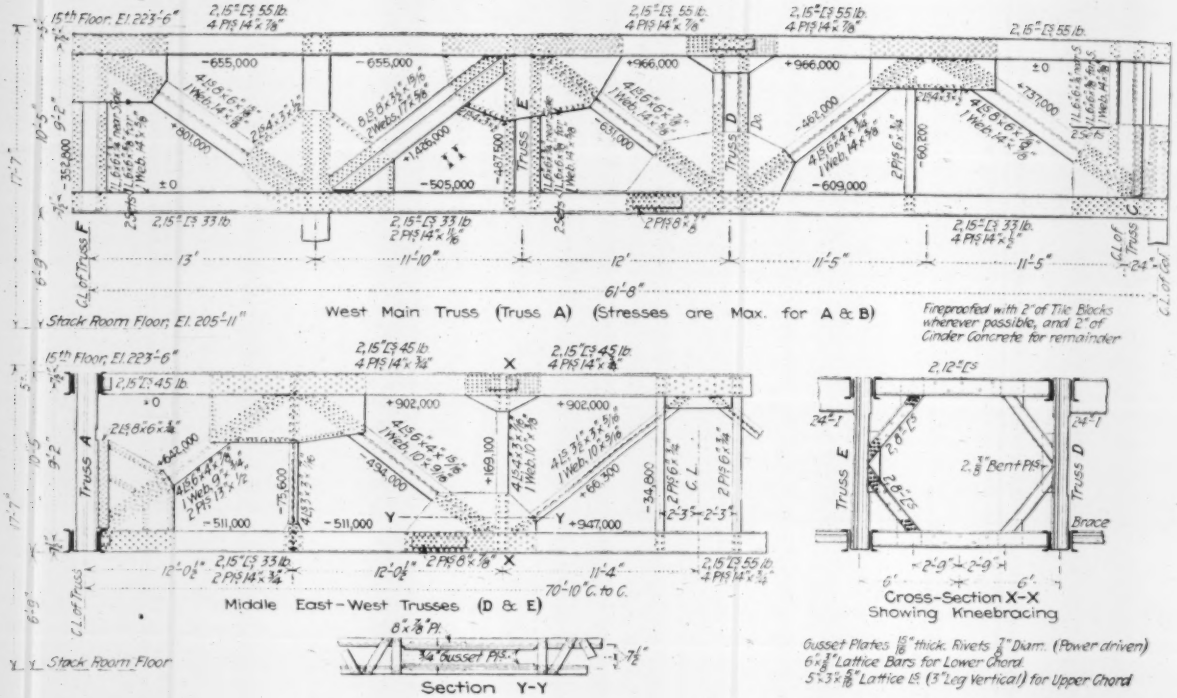

West Main Truss (Truss A) (Stresses are Max. for A & B)
Fireproofed with 2" of Tile Blocks wherever possible, and 2" of Cinder Concrete for remainder
Middle East-West Trusses (D & E)
Cross-Section X-X
Showing Kneebracing
Section Y-Y
Gusset Plates 15/16" thick. Rivets 7/8" Diam. (Power driven)
6"x3/8" Lattice Bars for Lower Chord.
5"x3"x5/16" Lattice Ls. (3" Leg Vertical) for Upper Chord

FIG. 3. TRUSSES CARRYING NEW SUPERSTRUCTURE OF ENGINEERING SOCIETIES' BUILDING

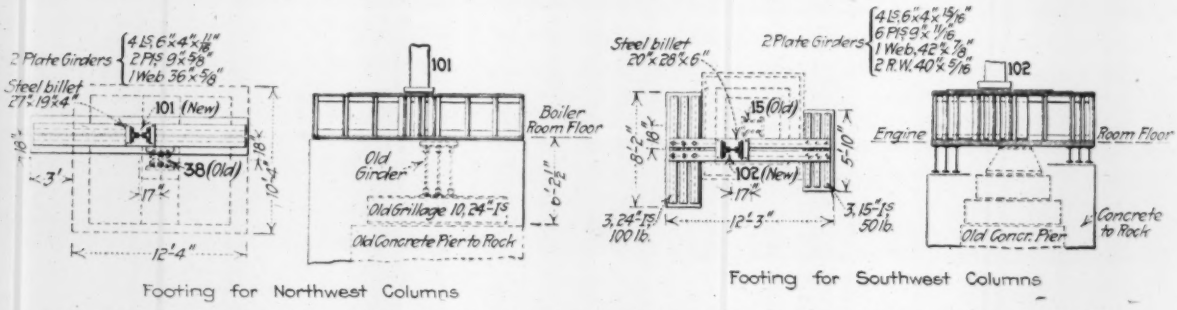


FIG. 4. FOOTINGS OF TWO OF THE NEW COLUMNS, SHOWING METHOD OF ENLARGING OLD FOOTING.3

the American Society of Civil Engineers—and is in charge of publicity for the committee. H. G. Morse, of 101 Park Ave., New York City, is architect. Purdy & Henderson, 45 East 17th St., designed the steelwork. Wells Construction Co. is the contractor. Mr. Morse was associate architect with Hale & Rogers in the construction of the original building. Similarly, Purdy & Henderson were the structural engineers and Wells Bros. the contractors for the old building.

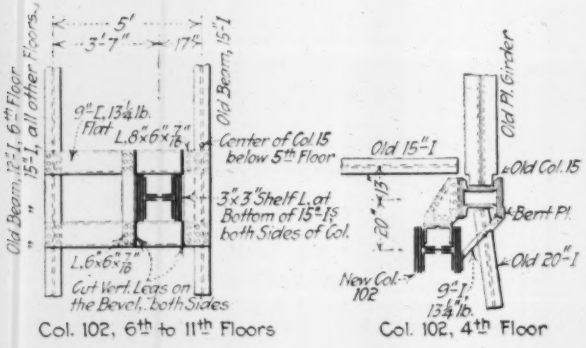


FIG. 5. TWO TYPICAL STAY-CONNECTIONS OF NEW COLUMNS

⁂

Anecdotes of I. K. Brunel, the famous English engineer, are related by the London correspondent of the "Indian Engineer," who was Brunel's last pupil. In building the suspension bridge at Hungerford, England, in 1836, to facilitate construction an iron bar 1½ in. in diameter and 1,000 ft. long was hung across the gorge and traversed by a basket worked with ropes. Passengers were allowed to make the journey at fares from 25c. to $1.25. An engaged couple got into the basket and were hauled out over the gorge, when something went wrong with the ropes and they passed the night suspended midway over the Avon. Brunel was an athlete and a man of great daring. At one time when he desired to drop a heavy plumb-line from the top of the cliff to the bottom he had a 3-in. plank shoved out over the edge of the cliff, and three men stood on the land end while he walked out on the end overhanging the gorge. He was accustomed to travel in his own carriage, drawn by four horses driven by two postilions. His valet rode in the dickey behind and used to hand cigars to his master through a hole in the back. For winter traveling the floor of the carriage was filled with straw, and one day this caught fire from the spark of a cigar. The valet called for the post-boys to stop, but Brunel opened both carriage doors, told the boys to drive on and kicked the straw out. In one of the Thames tunnels, when caught with several workmen in an inrush of water, he remained last of the lot to get out and then only with a broken leg from the impact of being washed against the shaft timbering.

Large Levee and Drainage System in Indiana

SYNOPSIS—Low lands drained and higher lands protected from flooding by 37 mi. of levee with drainage outlets fitted with flood gates. Dragline and wheeled-scraper work. The methods of construction are described.

Southwest of Vincennes, Ind. (in Knox County), is a tract of land of about 50,000 acres lying between the Wabash River and White River, and subject to overflow during high-water periods. The soil is rich and favorable for growing good crops, and the value of the land will be very much greater when good crops can be depended upon, without fear of floods. To protect this area, a system of about 37 mi. of levee is now about completed, with an aggregate of 1,684,350 cu.yd. of earthwork. This is known as the Brevoort levee system.

From the west boundary of the City of Vincennes a stretch of levee extends 21 mi. along the Wabash River nearly to its junction with the White River, a ridge of high land serving to close the lower end of the district. A second stretch of levee extends 10 mi. from this ridge along the White River. This ends at a low hill, beyond which is a 6-mi. stretch of levee along the River Duchee. Culverts with flood gates provide for the escape of drainage water, and eventually a pumping plant may be installed at the lower end of the district to take care of such water during flood periods.

The engineer for the Brevoort levee system is Jacob S. Spiker, of Vincennes, Ind., and he also acts as Superintendent of Construction on behalf of the landowners. The general contract was let to the MacArthur Brothers Co., of Chicago; the greater part was sublet to the W. J. Hoy Construction Co., of St. Paul, Minn., and the remainder to Oakford & Hutchinson, of Chicago. The Vincennes Bridge Co., Vincennes, Ind., has the contract for concrete culverts and flood gates. The total cost of the levee, with culverts and other works, will be about $450,000. The City of Vincennes will pay $10,000 and three townships will pay $32,755 on account of the road improvements. The balance of the amount is raised by assessment upon the landowners. The contracts were let Apr. 1, 1916, and required completion of the work by Dec. 1, in order to give protection against the spring floods.

The levees are 4 ft. wide on top, with side slopes of 2 on 1 and with a berm of 15 ft. between the borrow pits and the toe. The top is 3 to 5 ft. above the flood level of 1913. For the greater part of their length the levees are entirely new fills, but in places they are enlargements of existing (but lower) levees. The slopes are left as formed by the material dumped from the excavators, with no dressing or sodding, but they will be

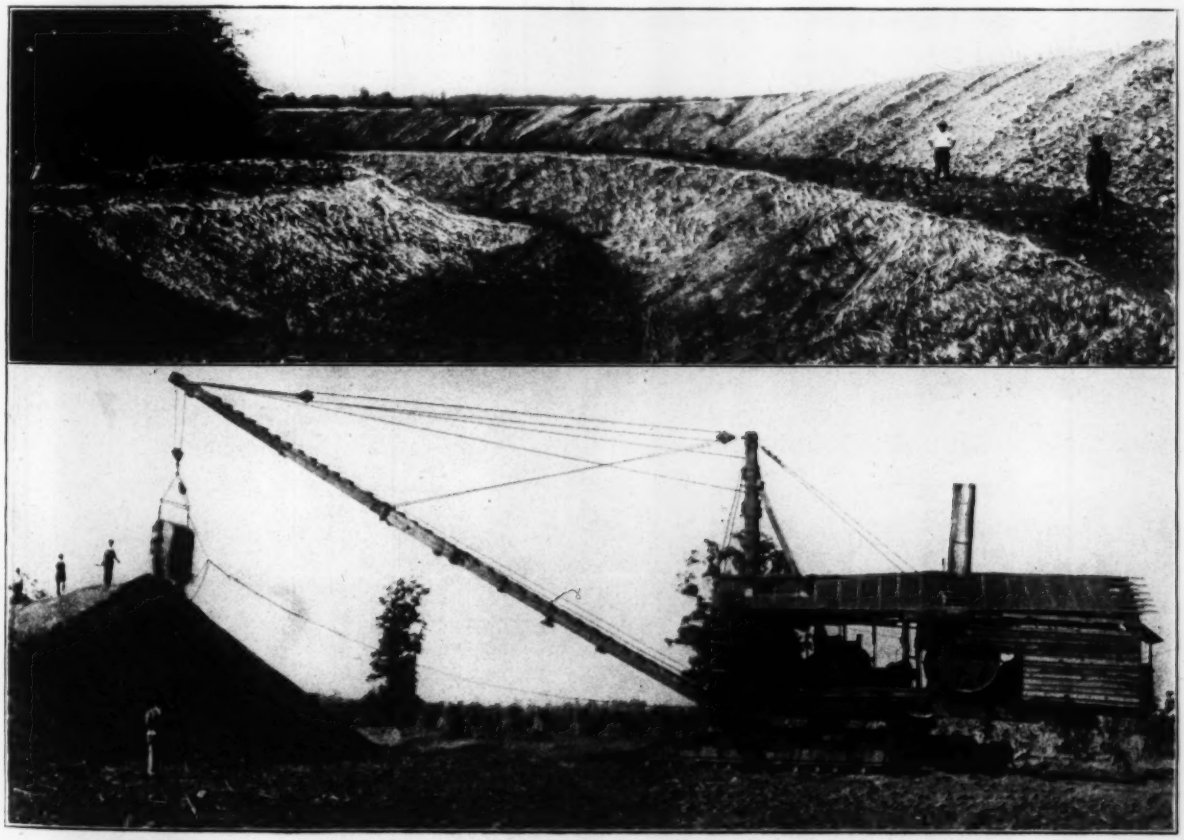


FIG. 1. BUILDING LARGE LEVEES IN INDIANA

The upper view shows the river side of a high levee, with borrow-pit and 15-ft. berm. The lower view shows a large dragline excavator building a levee

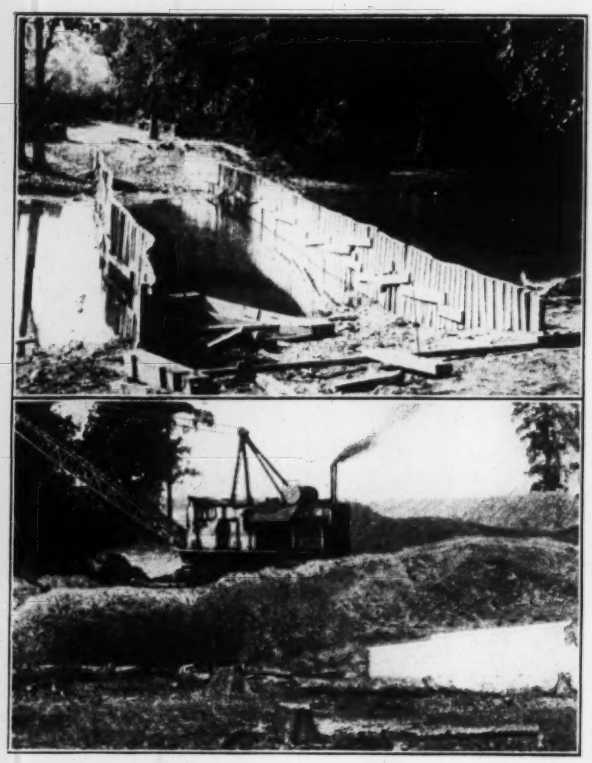


FIG. 2. LEVEE CONSTRUCTION WORK

The upper view shows double line of sheetpiling in base of levee crossing a stream. The lower view shows an excavator handling material from borrow-pit to spoil bank, to be placed later in the levee at the right. In the foreground is the outlet end of a concrete culvert.

sown to grass by the farmers and landowners. For enlargements, the old slope is cleared of grass and weeds and plowed before depositing the new fill.

The ground forming the base of the levee and the berm is cleared of trees, brush, logs, stumps, etc. Heavy stumps are blown out or pulled up, except that on the berm they may be cut off at the ground level or left 10 in. high. The base of the levee is plowed, teams being used for this work. Under new levees, a muck ditch 4x4 ft. is excavated, having the sides as nearly vertical as possible and not exceeding a slope of 1 on 1. Teams and slip scrapers are used for this excavation.

The material is mainly dry, including sandy and clayey soil. The former holds better against the water, as it packs hard and does not slough so much when water rises upon the slope. Part of the heaviest borrow-pit cut was in dry clay so compact that it had to be loosened by blasting before the shovels could handle it. In two or three places wet muck and soft clay have been encountered. The latter caused a slide in the fill; but after this had dried out and settled, it was covered with sand (brought up to the required levee section), and no further trouble is expected.

All material is taken from borrow pits on the outer, or river, side of the levee. A berm of at least 15 ft. is left between the borrow pit and the levee, and the depth of pit must not be so great as to encroach upon a 1:3 slope extending from the toes of the levee. The borrow pits are not continuous, but at intervals of not over 300 ft. there are traverses, or cross-banks, left, 14 ft. wide. To provide for continuous drainage through the pits, however, a cut is made across the land end of each traverse. Fig. 1 shows a long stretch of high levee.

With dragline work the levee fill is built up in two lifts as a rule, the first lift being shallow and covering the full width of base. The second lift is made by dumping the material at the level of the top of the fill. The largest machines, however, make the fill at one lift, as shown in Fig. 1. A man on top dresses the fill to grade and width. The maximum height is about 30 ft. On that part of the work shown at the bottom of Fig. 2 the height of levee and distance from borrow were too great for direct filling. The excavator therefore placed the material from the borrow pit in a spoil bank and then rehandled it from the bank to the levee.

On new work, the engineers set out center and slope stakes at 100-ft. intervals. On enlargements, the excavator follows the old levee, and the men on top of the fill keep the grade by sighting over three stakes with targets or boards.

The greater part of the work is being done by dragline excavators, but for about 8 mi. where the fill is low the work is done by wheeled scrapers. Here a force of about 125 scrapers is employed when in full progress, but this part of the work has been delayed owing to farmers

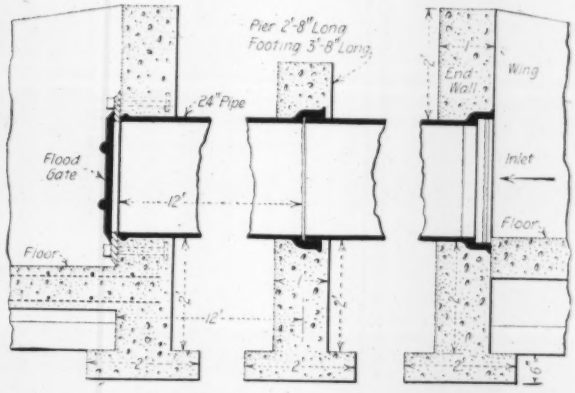


FIG. 3. CAST-IRON PIPE CULVERT, WITH CONCRETE SUPPORTS AND FITTED WITH FLAP GATE

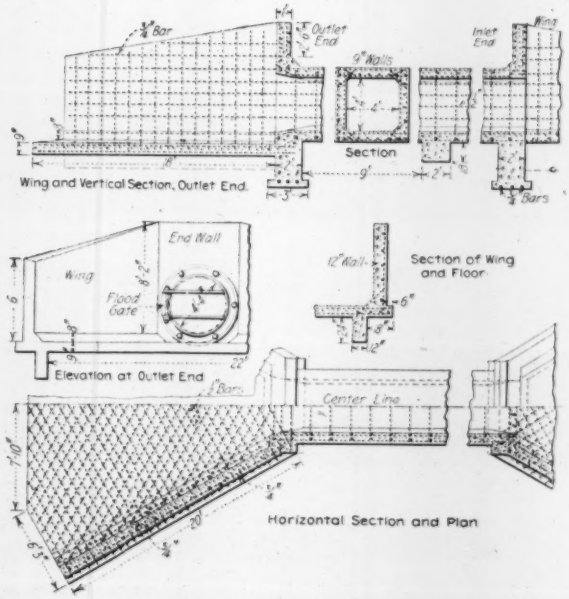


FIG. 4. REINFORCED-CONCRETE CULVERT IN LEVEE, WITH FLOOD GATE ON OUTLET

...ing to employ their teams on the land and having ...ne to rent for handling scrapers. With this method of ...orking the levee is built up in successive horizontal ...ers. The fill is made to allow for a shrinkage of ...% in dragline work and 10% in wheeled-scraper work.

There are 12 dragline machines now at work, and one more is being erected. The larger ones have 2- and 2½-yd. buckets, while two machines handle a 3½-yd. bucket on an 80-ft. boom. The machines are of the Bucyrus, Monighan and Lidgerwood types. These last (Fig. 1) have timber frames and booms and are erected on the site.

Most of the machines travel on rollers, but a few have caterpillars or are mounted on wheels on wide-gage tracks. The buckets have no teeth for working in sandy and wet soil, but only for hard compact soil. Coal is distributed by teams. Water is obtained at almost any point by well points driven 12 to 15 ft. into the ground and connected with a steam pump. The work is carried on in two 10-hr. shifts daily. For night work, electric light is used on the excavators, and acetylene and oil torches are used on the fill.

Where the levee is carried across the River Duchee, two parallel lines of sheetpiling are driven for a distance of about 170 ft., as shown in Fig. 2. These lines are 20 ft. apart and driven to a depth of 14 ft. They are single lines of 4x12-in. water-oak sheetpiles, not interlocked. Sheetpiling is used also under the culverts and gate openings. Round piles are used for foundations at these places.

Culverts and Open Drainage Channels

Where the work consists of enlarging and raising old levees, the new material is dumped on the outer, or river, side, the old slope being cleared and plowed so as to give a good bond or union for the new material.

The smaller culverts are of 18- to 36-in. cast-iron pipe, using lock-joint pipe in short lengths, with concrete under alternate joints. The ends have concrete head walls with wings and aprons, and the outer end is fitted with an automatic flood gate. These cast-iron flap gates have the hinge placed diagonally so that the gate closes by its own weight (or the pressure of water on the outside) except when the flow of water from the inside is sufficient to force it open. Larger culverts are of reinforced concrete, of box type, rectangular in section. The largest are 5x5 ft., but have the outer end tapered to a 5½-ft. circular section to fit the flood gate. These culverts have 9-in. walls, with 12-in. floor and roof. Figs. 3 and 4 show the culverts and gate construction. Fig. 5 is a view of one of the large culverts with 5½-ft. flood gate.

At two openings where larger waterway is desired, there is an open concrete channel, fitted with rectangular gates sliding vertically and operated by means of gearing. Each gate gives an opening 10 ft. high and 6 ft. 4 in. wide and is operated by a vertical screw or threaded stem working in a ball-bearing nut on a pedestal. The gates were built by the Caldwell-Wilcox Co., of Newburgh, New York. One of these structures has four gates and the other has two. In each case the gates are operated by gearing from a 6-hp. gasoline engine located at the gate.

To set the gates a derrick with 75-ft. steel box-lattice boom, 40-ft. mast and four logs for stiff-legs was erected, one of the stiff-legs bracing the mast against a tree. A ½-yd. mixer with 45-ft. elevator tower was installed, with spouts leading the concrete directly into the forms. The gravel for the concrete was brought from the stock pile in a small car with flat wheels running in small steel channels for rails.

Where the levee is at a distance from the river, roads must be carried over it to give access to the land on the outer side. These roads are built diagonally up the slope on either side, with a grade of 10% and a crossing 20 ft. at the top. They are made 20 ft. wide. In some places the original road along the river bank is closed and a new road built along the land side of the levee.

All concrete is a 1:6 mix, made with local washed gravel, in sizes ranging from 1¾ in. to fine sharp sand and with not more than 15% of voids. Wood forms are used. Deformed bars serve for the steel reinforcement.

There is a camp for the assistant engineers, inspectors, etc. It has sleeping accommodation for four or five men, but has to provide meals for 14 to 16 men. The contractors have their own camps.

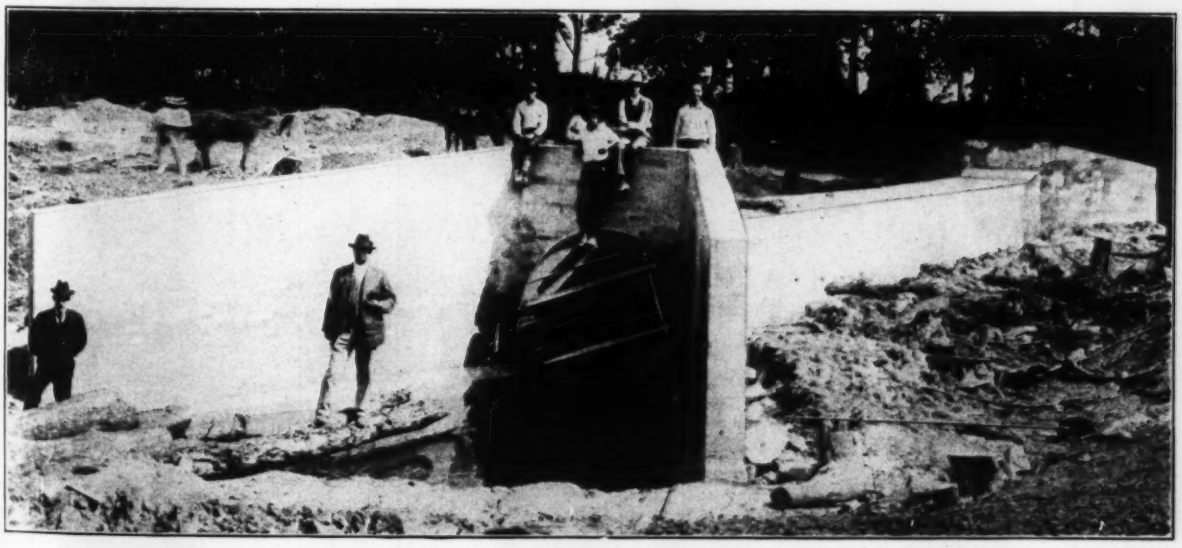


FIG. 5. REINFORCED-CONCRETE CULVERT WITH 5 x 5-FT. SECTION AND 5½-FT. FLOOD GATE

Notes from Field and Office

Concrete piles exposed after placing—Mending a tape in the field—Cold bituminous mixtures for plank floors of highway bridges—Keeping tab on revised drawings—Portable timber-framing machine—Keeping Los Angeles engineering records

Concrete Piles Not Affected by Deep Foundations Sunk Alongside

Good performance of concrete piles under unusual conditions was recorded during the construction of the new Waterside power-house extension of the Louisville Gas and Electric Co. on the south bank of the Ohio at Louisville. Foundations for building columns were constructed before the condenser well inside the turbine house was sunk. The column foundations consisted of "Pedestal" piles placed for a working load of 30 tons and (on testing one pile in each group) showing generally only about $\frac{3}{16}$- to $\frac{1}{4}$-in. settlement under 60-ton test load. Later, the condenser well, 55x64 ft., was sunk between the turbine-house column foundations.

This well passed close to a number of the pile groups. It was put down by sinking the reinforced-concrete well structure by open excavation inside and loading on top. No trouble was found in keeping down the water in the bottom of the excavation; and the soil gave no difficulty, although pretty heavy loading applied by a sand box on the upper rim of the well had to be used in order to get it down to its final depth of about 56 ft. The side of the well passed so close to some of the piles that part of the side of a pile had to be cut away to provide safe clearance for the well.

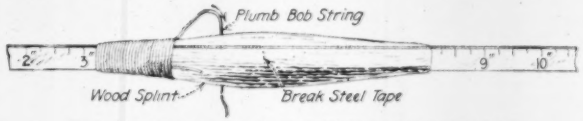
Because of this proximity of the piles it was thought that the near pile groups might have been weakened in bearing power. A suitable selected pile was therefore subjected to a load test. The loading was carried up to 57 tons without any indication of reduced bearing power. The conclusion was that the piles were unaffected and had just as high load capacity as before sinking of the well.

The engineers for the design of the new station are H. M. Byllesby & Co., Chicago, Ill. The construction of the new station is being done by company labor.

Field Mend for Steel Tape*

By Hale H. Hunner†

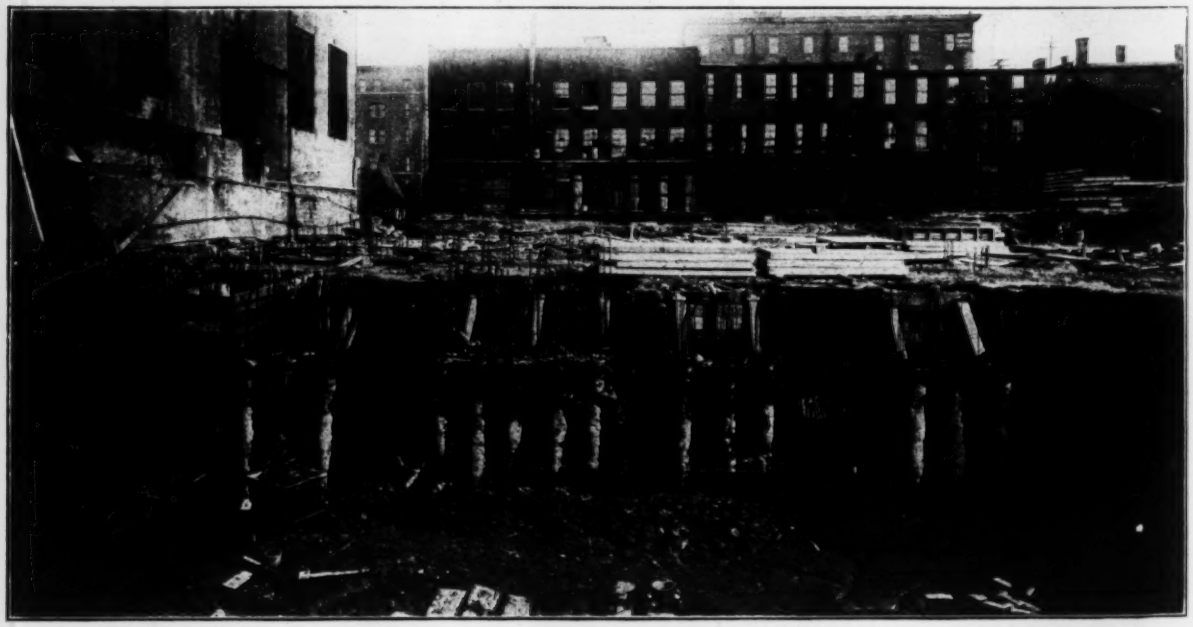
Although there are several quick-repair menders for steel tapes on the market, it usually happens that they are in the office when the tape breaks. I was taught this simple mend by a practical surveyor several years ago, and



MENDING A TAPE WITH WOOD AND STRING

have used it a good many times since and never had the least bit of trouble in making it hold as long as I cared to leave it on. I have worked for a week in the woods with two of them on the tape without having to be touched except for an occasional soaking.

*Reprinted from "Engineering and Mining Journal."
†920 Third Ave., Hibbing, Minn.



CONCRETE PILES EXPOSED BY CONDENSER-WELL PIT

When the tape breaks, cut a straight piece from a green alder or willow about 3 in. long. When the stick is split down the center and peeled, it should just cover the tape laid lengthwise. Smooth up the split faces and shave down the outside from the center of each half to a thin edge. About 3 ft. of plumb-bob string or stout cord will serve to wrap the splints. The cord should be wrapped as tight as possible each time and care taken to see that the binding does not have a chance to slacken up. When the splint is nearly half wound, place the broken ends together right side up and finish winding until the splint is entirely covered. A minute's soaking in water will remove any possibility of slipping. If it should slip at all, it will pull entirely out, thus there is very little chance of getting wrong chainage. It slides through the brush and around rocks with very little hindrance and while it puts a stiff place in the tape the advantage of a quick field repair overbalances the disadvantage.

Keeping Tab on Revised Drawings

By Albert M. Wolf*

In supervising a large concrete building job at some distance from the main office where the detail plans are made, there is ever present a danger that the latest plans may not be used by the field superintendent and the construction gang. The structural plans for a concrete building are seldom completed when bids are called for, the usual practice being to have the footing design and column schedule completed at the time so that the material can be ordered and work started without delay after awarding the contract. The detailing of the superstructure is usually carried on slightly ahead of the construction work, necessitating the issuance of several progress prints of the same plan.

The writer has found it worth while to issue a memorandum at the end of each week, giving the date of the latest print of each plan issued. These memo's are typewritten on standard specification-size sheets. Blueprints are made from them and are sent to the superintendent and contractors, who post them in the various field and main offices. Blueprints are used since they are more conspicuous and more apt to be regarded as a part of the plans than are carbon copies. The following form is used:

PLAN MEMORANDUM

Date.....

Building for "A. B. Co." City.....

Post in a Conspicuous Place.

The latest prints of plans to be used are dated (with rubber stamp) as follows:

Sheet No..... Description..... Date.....

These memoranda are sent out on Saturday of each week, except when only one or two revised prints have been sent out since the last memorandum.

Each time a sheet is revised or some new feature is added, a note regarding same (with date made) is placed on the tracing in a space provided in the title of the sheet. In addition to this each print is marked with rubber stamps as shown herewith.

The upper stamp calls attention to the fact that the print contains some revision or addition not shown on previous prints, and by referring to the revision list (in title) the extent of the change can be found at once. If the print bears a later date than the one noted for this sheet on the memorandum sheet posted in the field office, the memo is revised by the superintendent to show the date of the latest print. In this way a careful record of the latest prints is kept, and anyone not familiar with all the details of the work can quickly find, by referring to the memorandum sheet, which prints should be used for construction work, and thus costly errors due to use of superseded and void plans are avoided.

REVISED PRINT
Destroy all prints previously sent you

THIS PRINT MADE
Dec. 20, 1916

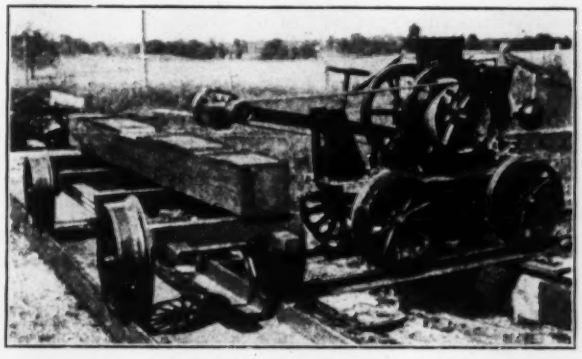
PRINTS MARKED WITH THESE TWO STAMPS
Upper stamp is 3¼x1 in.; lower is 2⅝x⅝ in.

*Principal Assistant Engineer, Condron Co., Industrial and Structural Engineers, Chicago.

Portable Timber-Framing Machine Used on Keokuk Bridge

The portable machine for gaining and framing timber for various construction and repair work, shown in the accompanying figure, was used on the new Mississippi River bridge at Keokuk, Iowa, where its work was reported to be quicker and better than hand gaining. Similar machines are built, for sale, by the inventor, J. E. Toohey, of Grand Rapids, Mich.

The machine consists of a small car of 2-ft. gage on which is mounted a gasoline engine driving a cutter head 2 in. wide (for gaining) or a small circular saw carried on the end of a hinged steel arm. The position of this arm is adjustable by means of a screw passing through its heel, and the arm may be clamped to vertical plate guides by a bolt passing through slotted holes in these plates. The timber to be framed is placed on a four-wheel truck running on a track of 2-ft. gage at right angles to that on which the machine stands. By means of a vertical lever attached to one of its wheels, the machine is moved forward and backward, so that the saw or cutter head passes across the timber, making a cut at each stroke. As each cut is made, the truck carrying the timber is moved forward to position for the next cut.



PORTABLE MACHINE FOR FRAMING TIMBERS

The track for the timber truck on the Keokuk bridge work was made by laying a 24-in. I-beam down flat. The machine track was made of old rails.

In tests made on the Peré Marquette R.R., by C. S. Sheldon, Engineer of Bridges and Structures, three men in a 10-hr. shift framed 400 bridge ties 8x8 in., 10 ft. long, cutting two 13-in. daps or gains in each tie. The cost was $8.25 for labor and 59c. for fuel, or about 2¼c. per tie. Handwork on similar ties cost 15c. per tie. The machine has been used also by the Strobel Steel Construction Co., of Chicago (in the flooring of the new bridge over the Mississippi at Keokuk, Iowa), and by the McClintic-Marshall Co., of Pittsburgh.

Building Telephone Conduits

The conduits used by the Wisconsin Telephone Co., at Milwaukee, are of vitrified clay and mainly of the multiduct type. Groups of separate single-duct lines (embedded in concrete) are adopted in some cases for curves, etc. With a single unit of multiple-duct conduit no concrete base is used, but a 3-in. layer of concrete is placed on the top (and extending partly down each side) to protect the conduit from injury in case of street excavation. Most of the work has two or more units of duct, and here a 4-in. concrete base is employed, extending 3 in. beyond each side of the conduit. A 3-in. concrete cover is laid also, with its bottom the same width as the conduit line and its top the same width as the base. Earth is packed along the sides of the conduit between the projecting lines of the concrete.

The concrete for the conduit base and cover and for the manhole floors is a 1:4:8 mix; for the walls and the roof of the manholes it is 1:2½:5. The conduits are laid in 1:3 mortar. Broken limestone is used for concrete. Washed gravel is not found satisfactory, unless it is graded at the work, as it tends to segregate in shipping, so that one load will be mainly coarse and another mainly fine. The concrete base averages 0.0324 cu.yd. per lin.ft. of one-unit conduit.

In building conduits the concrete is mixed in a portable drum mixer of 4½-cu.ft. capacity, driven by a gasoline engine. The machine is not self-propelling. It is located at a street intersection, convenient to a hydrant, and the materials are wheeled to it from a stock pile deposited by motor trucks. The same machine is used in building the manholes and in putting back the concrete base for paving. The concreting gang consists ordinarily of one operator, one man to charge, and three to five men wheeling concrete to the trench, this number depending upon the distance it has to be wheeled.

The use of trenching machines for this conduit work was described in *Engineering News*, Dec. 7, 1916. The construction is done by company forces and is under the direction of C. W. Wilson, Superintendent of Exchange Construction.

Cold Bituminous Mixtures for Plank Floors of Highway Bridges

By B. H. Piepmeier*

There are numerous steel highway bridges in use on which it is necessary to maintain wood floors, primarily because the light flimsy structures that have been built will not carry a heavier floor. A plank floor must be replaced about every five years, and when it is subjected to heavy traffic it is necessary to replace it every one to three years on account of wear.

The poor quality of present bridge timber, together with its advance in price, has led engineers to devise some form of light and yet durable reflooring material. Creosoted bridge plank has proved very economical on isolated bridges where traffic was light and wear was not considerable. Wear, however, is the most serious problem on the average highway bridge floor; hence, some form of treatment seemed necessary to prevent excessive wear on the wood.

In Illinois a number of old bridge floors have been replaced with creosoted subplank and then surface-treated with a bituminous material covered with stone chips or torpedo gravel. The bituminous mixture was maintained so as to resist the wear of traffic. It has been found that such bituminous surfaces can be kept in condition at less expense than the continual repairs and renewals that are necessary where ordinary plank flooring has been used.

The expense connected with securing creosoted bridge plank, together with the delays and inconvenience of applying the usual bituminous wearing surface, discouraged the average road official from placing such floors on the numerous short spans that are scattered in all parts of his district.

The writer has made several investigations with different materials and mixtures with an idea of finding a product that was low in first cost and that could be used by the average road official with little trouble. The

*Maintenance Engineer, Illinois State Highway Department, Springfield, Ill.

FIG. 1. SHOWING CONDITION OF OLD BRIDGE FLOOR PRIOR TO APPLYING BITUMINOUS MIXTURE

FIG. 2. SHOWING BITUMINOUS SURFACE ON OLD BRIDGE FLOOR AFTER SEVERAL MONTHS' SERVICE

material that has proved most successful is a mixture of stone chips (¾-in. down to dust, with the dust removed) and an emulsified asphalt that could readily be mixed with the aggregate without either being heated in special apparatus.

The advantages of the emulsified asphalt are that it can be used cold, can be thinned with water, can be used on a wet day, and will permit thorough cleaning of the plank with water prior to its application. The use of such a bituminous product insures a thorough coating of the aggregate and at the same time will not permit a surplus of the material that might cause creeping, bleeding or leakage through small cracks that may exist in the subflooring.

The dense mixture of stone chips and sand, becoming thoroughly coated with a film of asphalt, readily packs under traffic and forms a mat that resists in a measure the wear of traffic. It also waterproofs the surface so that, when properly maintained, it will ordinarily save the untreated floor from decay until some time in the future when the old bridge is replaced with a more permanent structure.

Applying the Bituminous Mixture

Bridge floors should have a crown of from 2 to 4 in.; the plank should be fitted as close together as possible, and all cracks should be filled with wood strips prior to the application of the bituminous mixture. The plank should be cleaned thoroughly with water. The mixture should be spread evenly over the entire surface to a thickness of 1 to 1½ in. The surface should then be sanded lightly and then tamped or rolled. Where tamping or rolling is not convenient, the surface should be watched carefully during the first few days to see that it is not displaced by traffic. It is not necessary to close the bridge to traffic while the mixture is being applied or during the time it is setting, which is an important factor in its favor.

The bituminous mixture should be made by mixing about 1 gal. of the emulsified asphalt with 1 cu.ft. of aggregate. The bituminous compound should be stirred thoroughly and in some cases a slight amount of water added to make it liquid before it is mixed with the aggregate. The materials may be mixed by machine or by hand until all stones are coated thoroughly before being applied on the floor.

Under ordinary conditions, such treatment can be applied at a cost of 25 to 30c. per sq.yd. including labor and materials, but excluding the bridge timbers. This is about one-half the cost of mastic surfaces where it is necessary to heat the bituminous material and build up a wearing surface by successive layers of bituminous material and stone chips or torpedo gravel; and about one-fourth as much as renewing the bridge floor with ordinary hardwood lumber. Such treatment may be used to great advantage in highway bridge work as it will reduce the maintenance cost and at the same time make old structures much more serviceable. The reduction of impact, by the smooth surface, compensates for the slight additional dead-load.

The foregoing experiment and investigation has been carried out for the Illinois State Highway Department, with the consent and authorization of William W. Marr, chief state highway engineer, and the author is maintenance engineer.

Filing the Records of City Engineer's Office at Los Angeles, Calif.

The filing of the city's engineering records in Los Angeles is fully explained by George R. Tilton, Jr., of the City Engineer's Office. The classification is as follows:

1. Records showing location are termed maps.
2. Records showing profiles are termed profiles.
3. Records showing detail are termed plans.
4. Fieldbooks, deeds, etc., are self-explanatory.

Mr. Tilton says: "The conglomeration of sizes is sorted into lengths and a series of numbers is allotted to each length in each classification, as follows:"

1 to 249 Roll maps 12 in. wide and under.
250 to 1,999 Roll maps 12 to 18 in. wide.
2,000 to 3,999 Roll maps 18 to 24 in. wide.
4,000 to 5,499 Roll maps 24 to 36 in. wide.
5,500 to 5,999 Roll maps over 36 in. wide.
6,000 to 9,999 Flat maps of a uniform size.
10,000 to 10,249 Roll profiles 12 in. wide and under.
10,250 to 10,999 Roll profiles 12 to 18 in. wide.
11,000 to 14,999 Roll profiles 18 to 24 in. wide.
15,000 to 19,999 Flat profiles of a uniform size.
20,000 to 20,999 Roll plans 12 in. wide and under.
21,000 to 21,999 Roll plans 18 to 30 in. wide.
22,000 to 24,999 Roll plans 30 in. wide and over.
One up for fieldbooks, deedbooks, etc.

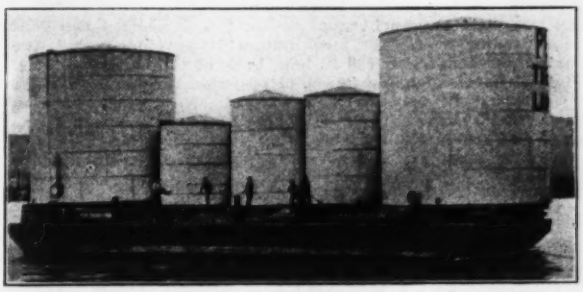
As soon as one of these series of numbers is exhausted the alphabetical prefix is assigned and the series re-run.

The actual indexing and numbering is now ready to be done rapidly and accurately. Each record is numbered with a stamp so that all numbering is of uniform size and in the same location on the record. Each classification is listed in a "list book" and indexed both in the "division index" and "alphabetical index" so that it can be found either by name or location, one of which it is necessary to know. In the division index the records are arranged according to year made.

Sixteen years ago, when this system was inaugurated, the area of the city was 13.26 sq.mi.; today it is 337.92 sq.mi. This continued expansion has not impaired or confused the early records in any way, in fact an early record is found as quickly as a late one. To keep this system up to date and the records in place the entire services of one man have been found necessary.

FINE AGGREGATE

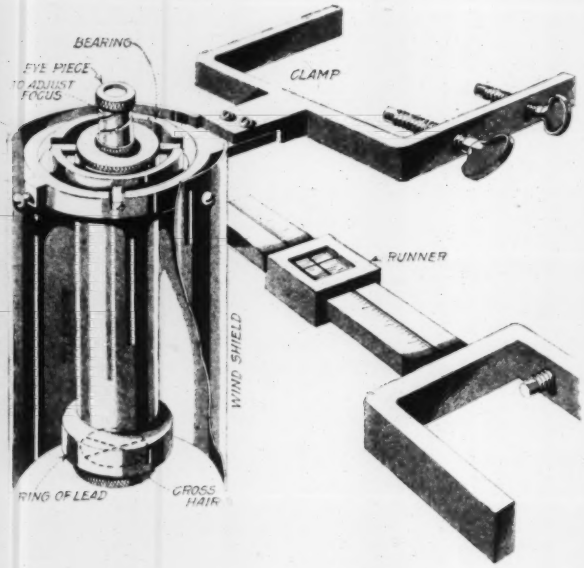
Transporting Large Oil Tanks by Scow was the method employed when the Point Wells, Wash., storage plant of the Standard Oil Co. (California) was recently enlarged. The receptacles were taken from the plant at Seattle, 14 mi. from Point Wells. One scow carried two tanks 30x30 ft., two



FIVE OIL TANKS TRAVEL 14 MI. BY SCOW

16x20 ft. and one 16x16 ft., as illustrated. The largest tank, 90x30 ft., was loaded on two scows. The six receptacles have a combined capacity of 1,824,686 gal. The Olsen-Nicholson Co. was the contractor.

Plumbing Telescope Available for Building Work—The Pluckham plumbing telescope, recently developed, is intended as a substitute for and as a considerable improvement over the plumb line. Plumbing with this instrument is, of course, an operation independent of wind. The instrument consists of a telescope (18-power) fitted with crosshairs, suspended in a gimbal bearing to hang plumb. Oscillation is reduced by means of a heavy ring of lead at the bottom of the telescope. The instrument is fastened to the flange of a column by a clamp and can be fastened in the same manner to the corner of a building. A case protects it against wind. At the foot of the column is clamped a target graduated in inches, having a runner as on a slide-rule. In sighting through the telescope the intersection of the cross-hairs will be in line with the zero mark on the target when the column is plumb. Charles Pluckham, the inventor, is associated with Charles Bizozer, 526 W. 158 St., New York City. Mr.



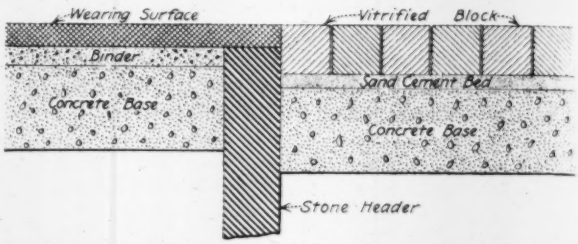
DETAILS OF THE PLUMBING TELESCOPE

Bizozer states that they are ready to manufacture and sell the instrument at a reasonable price. He says that one of these telescopes has been tried out by the George A. Just Co., of Brooklyn, N. Y. The details of the instrument are shown in the sketch.

Unusual Expansion Trouble in a Steel Bridge was met a few years ago in the case of an old street bridge in the Central States. Like many other old bridges, this one had been made to do duty as a street-railway bridge, though not designed for such service. After a time the bridge showed signs of weakness, and finally a bridge engineer was called in to report upon its safety. A long viaduct approach at one end made a fairly sharp turn near the beginning of the river bridge, and at this point, as the inspecting engineer found, one bent of the viaduct was strongly anchored by a heavy wire rope guy to a deadman on the inner side of the curve. The bent showed some outward distortion and the engineer was told that the anchorage was intended to keep the bent from tipping over. On examination it developed that the whole approach, about 600 ft. long back of the turn, was built solid, without expansion joints. Expansion had simply shoved the corner bent forward and outward. No special question was raised by this expansion trouble because the viaduct was found to be so badly corroded in its floor system as to require immediate stopping of traffic and prompt construction of a new bridge.

Marking Brown (Van Dyke) Prints White—In your issue of Dec. 14 Edward Godfrey gives a method which I have no doubt works well, but it necessitates keeping on hand a supply of hydrochloric acid and peroxide of hydrogen. For several years past I have used with perfect success a weak solution of corrosive sublimate. This may be conveniently made by dissolving a small tablet of bichloride of mercury (ordinary antiseptic tablets) in a small quantity of water and using this as ink, with pen or brush. A bottle of Bernay tablets (100) may be had at any drug store for 25c., and will keep indefinitely.—Henry E. Elrod, Interurban Building, Dallas, Tex.

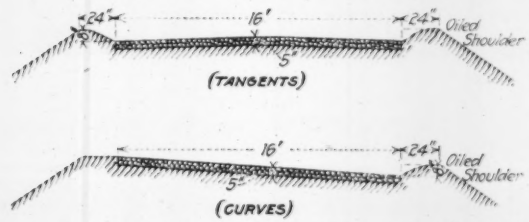
Sunken Stone Header Prevents Failures in Paving—Baltimore, Md., has adopted a detail of pavement construction to prevent failures at such points where a hard paving material like granite block, brick or wood block adjoins a softer material like asphalt. This detail is as follows: A well-jointed stone header, 12 in. or more in depth and 4 or 5 in. in width is constructed across the street parallel to and 1½ in. below the finished cross-section. The concrete base is placed on one side of the header for the block pavement, and on the other side for the asphalt pavement. The blocks are laid tight



SUNKEN STONE HEADER PREVENTS FAILURES IN PAVING

against the header, which in case of a 3½-in. vitrified block gives a 2-in. bearing. When the asphalt is laid, the binder course is brought flush with the header; and the topping or wearing surface is laid over the header to the finished contour of the street, thus leaving the header 1½ in. below and entirely hidden from view.—Harry D. Williar, Jr., Assistant Engineer, Baltimore Paving Commission.

Oiled Road Shoulders solved the storm-water protection problem on a mountain road in San Bernardino County, California. This mountain road with a maximum grade of 5% presented a serious problem in the protection of high embankments from the wash of storm water running off the paved surface. The problem would have been simple if funds had been available for concrete curbs and gutters. Instead the following plan, illustrated in the accompanying cross-sections, was adopted: The shoulders for 2 ft. in width were raised from 6 to 8 in. by filling with the adjacent gravelly soil, and were rounded off to easy curves. The shoulders were then given two coats of 75% asphaltic oil, each coat being properly sanded. Cutouts for the water were provided



OILED ROAD SHOULDERS, SAN BERNARDINO COUNTY, CALIFORNIA

at safely placed points and at culverts. This method of construction formed an earth curb, and the pavement acted as the gutter. The oiled shoulders have a sufficiently hard surface to resist erosion and also serve to protect the edge of the macadam from breaking down under wheel traffic. There was a considerable saving over standard practice, the cost being only about 2½c. per lin.ft. of shoulder—J. S. Bright, Jr., Engineer, San Bernardino County Highway Commission, San Bernardino, Calif.

Durability Tests of Wood-Block Pavement—Inspection of an experimental piece of treated wood-block pavement, laid in 1906 by the City of Minneapolis in coöperation with the United States Forest Service and various lumber manufacturers and wood-preserving companies, has revealed the fact that white birch is wearing as well as longleaf pine, and that sapwood of timber if well treated is practically as durable as heartwood. Data thus far recorded and analyzed at the Forest Products Laboratory at Madison, Wis., indicate that in order of efficiency the six species used in the experiment rank as follows: (1) Longleaf pine and white birch; (2) Norway pine; (3) tamarack and eastern hemlock; and (4) Western larch. Douglas fir blocks were also included in the experiment, but were laid at a later date than the other species and no definite conclusions in regard to their relative durability can be drawn at this time. When this pavement was laid the traffic on it was principally steel-tired, horse-drawn trucks, with few motor vehicles. It is now mostly motor traffic.

Editorials

Progress in the Art of Tunneling

The adoption of the shield method for construction of a small tunnel in Milwaukee in fairly good ground is one of various recent occurrences that tell of progressive, original activity in the field of tunneling. It is a fact that tunnel construction is among those fields of civil engineering work where marked advance is being made.

Within the past month two compressed-air tunnels of great difficulty were holed through, the Old Slip tunnels under the East River at New York. Various elements contributed to the success, which in the aggregate mean distinct progress in the art. Rapid control of face work, deep and wide blanketing of the river floor, and a highly original void-filling method—"grouting" with gravel by air ejection—are the chief of these elements.

A few months back the completion of the Rogers Pass tunnel, a sound-rock tunnel, signalized the brilliant success of a radically novel method of attack in rock. The system of blasting in rings from a central pilot tunnel, a bold innovation, was the key to success. Though centuries of prior art in rock tunneling were available, sound engineering in this case lay in abandonment of precedent.

Precedent was cast aside similarly in the new Cleveland intake tunnel under Lake Erie, which also was holed through a few weeks ago. The stereotyped form of lining for shield tunnels—cast-iron segments—was dropped, and a lining of concrete blocks was substituted. The economy of this expedient is obvious, iron being costly. But whether a long tunnel, with all its contingencies and hazards, could be built of concrete blocks in successful manner had to be proved by experience.

With new activity thus moving in the field of tunneling, further development is sure to result. As tunnel construction is cheapened and its range of application widened, it will be more frequently applied.

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Good Business Methods in Enlarging the Engineering Societies' Building

Even more interesting than the technical features in the work of adding two stories to the Engineering Societies' building, described in this issue, was the skill with which the undertaking was piloted through some critical stages. While the negotiations between the several societies were going on, the New York City authorities announced the early enactment of an ordinance limiting the height of buildings which would have made the projected addition to the building to accommodate the American Society of Civil Engineers impossible. In order to save the day it was necessary to prepare plans and file them with the Bureau of Buildings before the passage of the new ordinance. This required a considerable outlay of money for the preparation of plans, at a time when it was uncertain whether the Civil Engineers' membership might not reject the proposition. The society's letter ballot could not be taken and canvassed early enough to permit the plans to be prepared and filed after the vote was counted. Under these circumstances the leaders in the conference showed their faith in the project by ordering the plans prepared and filed at once. The outcome of the Civil Engineers' vote abundantly justified their courage.

At a later stage, the steadily rising prices of materials created another situation in which quick decision was required before all the formalities of voting on contracts could be complied with. Bids for the major part of the work were obtained that called for immediate acceptance to forestall a very considerable rise in price. Again the officials in charge of the work seized the opportunity and made a prompt decision—accepting the contract without waiting on red tape.

The efficient handling of this engineering society enterprise is a matter for general commendation. It proves that even the involved routine of society management can be bent when necessary to meet the exigencies of urgent business matters.

Already it has become practically certain that the cost of adding the three stories will exceed the advance estimates, because of the skyrocketing of prices. With only a little more deliberation in handling the job, however, the increase would have been much greater. As it is, the work will go through without financial strain on any of the interested societies.

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Army Engineer Corps Commissions for Recent Technical-School Graduates

A special effort is being made this year to interest young, qualified engineers to take the coming examination for appointment as probationary second lieutenant in the Corps of Engineers, United States Army. Up to now it has been required that candidates for appointment must not only pass an examination, mental and physical, to enter which they had to be between 21 and 29, unmarried and a graduate of an approved technical school, but that they also have the preliminary qualification of being eligible for appointment as Junior Engineer in the Engineer Department at large, which itself was attained only by examination.

For the examination to be given next summer, Gen. W. M. Black, Chief of Engineers, has recommended to the Secretary of War that the Junior Engineer requirement be waived. The candidates, therefore, will not be under the necessity of taking two examinations, and it is probable that practical engineering experience will not be considered so essential in the one examination as it has hitherto in the first of the two examinations prescribed. General Black calls attention to the fact that the five young men recently commissioned in the corps, brief statements of whose careers were given in last week's *Engineering News*, have not had extensive engineering experience and adds:

This is as it should be, for the reason that the best material for officers comes from the very recent graduates

of technical schools, men who are still young enough to undergo further instruction in the special duties which fall upon the Corps of Engineers and which are not provided for by the training received in technical schools. For the best results, officers of Engineers should start their service early in life, and every inducement is being extended to the recent graduates of technical schools to become candidates for appointment in the Corps of Engineers. Every effort is being made, through the kind coöperation of the faculties of some of the leading technical schools, to insure that the examination shall be entirely reasonable, so that a well-qualified candidate will be successful.

The opportunity for young engineers to secure responsible and honorable positions and at the same time to serve their country seems brighter than ever before. It is to be hoped that many of the large body of those qualified will present themselves for examination. Particulars can be ascertained from the office of the Chief of Engineers, United States Army, Washington, D. C.

Concreting à la Mode

The day after Christmas a pedestrian hurrying up Broadway over the timbering that for many months has served as temporary subway roof and sidewalk pavement might have had his attention arrested by a pile of concrete—the size of a dumped two-ton load of coal—fully mixed but dry, occupying most of the curb half of the sidewalk. The temperature, by official record since obtained, was 31° F. in the shade, and the December sun was not doing much to raise the mercury. Laborers were shoveling this mixture into barrows and were wheeling them to a near-by hole leading into the unknown depths of the subway structure. At the top of the hole a foreman, by dress and address, was controlling the business end of a hose reaching from a city-hydrant connection. From this hose he merrily played a good-sized stream into the half-turned barrow and the dry mixture was forced by sheer weight of the water piled up behind it to slide out and into the chute. At the end of the load some vigorous hydraulicking dug out the gobs of dry mix clinging to the corners of the barrow, at the same time dumping a few extra gallons of water down the chute.

That is all, except that the Broadway subway is being built by a well-paid expert contractor under the direction of high-salaried expert engineers and that at times one wearies of printing and preaching the elements of good practice in mixing and placing concrete.

Boston Rebuked for Unjust Treatment of Its Engineers

A severe condemnation of the present administration of the City of Boston and its treatment of its engineering staff is contained in a recent report of the National Board of Fire Underwriters:

The organization of the Metropolitan Water and Sewerage Board is excellent, and the officials are competent. In the City Water Department the recent discharge of employees for reasons other than lack of fitness for their positions cannot fail to have an effect on the morale of the department and the willingness of competent and progressive men to enter its service.

This condition of affairs has not failed to have its effect and is directly responsible for the incomplete and deplorable status of the high-pressure fire-service system, described in a special report of the Board of Fire Underwriters, an abstract of which appears elsewhere in this issue. This report has, fortunately, received wide publicity in Boston, and because of its source and importance it is sure to receive the careful consideration of the city's merchants, property owners and substantial business men; let it be hoped that the effect will prove beneficial.

About a year ago the honorable mayor of Boston "fired" 17 members of the staff of the Department of Public Works on 48 hours' notice, because they had not been active in reëlecting him, and notwithstanding that all were nominally under civil service and had been in the employ of the city from 7 to 41 years. The way for this action had been prepared long before by letting go the efficient engineer-commissioner of the department and substituting a politician. Some of the decapitated employees were reinstated, three by orders of the courts to which they had appealed. But the damage done is irreparable, so long as Mayor Curley remains in office.

Nor is it the Department of Public Works only which is suffering. The report of the National Board of Fire Underwriters, above quoted, states further that the Boston Fire Department, which formerly ranked among the most efficient, has failed to maintain its previous standing, although appropriations have been liberal. Inside intrigues, aided by outside politicians, are tending to destroy its discipline and efficiency.

In the meantime, with its high-pressure fire-service installation incompleted and dragging along, and the Fire Department losing its efficiency, the City of Boston faces a conflagration hazard which only those familiar with the congested parts of that city can fully appreciate. Such conditions in a city of the wealth and standing of Boston are intolerable; and it ought not to require a conflagration or an earthquake to bring about a reform.

Saving the Horseshoe Fall at Niagara

By the terms of an international agreement between Canada and the United States the former country may divert from the Niagara River 36,000 cu.ft. per sec. for the development of hydraulic power, while the United States on its side may divert 20,000 cu.ft. per sec. for the same purpose. Congress has hitherto permitted the diversion of only 15,600 cu.ft. per sec. on the American side, but an emergency created through the diversion for Canadian use of current hitherto sent across into the United States has caused the introduction in Congress and passage by the Senate of a resolution permitting the companies on the American side to divert 4400 cu.ft. additional for power development.

This permit in only temporary, terminating on July 1, but it has excited the alarm of the guardians of Niagara. A call to rally all forces to defeat the measure is sent out by E. H. Hall, Secretary of the American Scenic and Historic Preservation Society. In a letter published in the New York *Times*, Jan. 3, Mr. Hall says:

The friends of Niagara who do not wish to see the cataract's beauty further impaired should send their remonstrances at once to their Congressmen and later, if necessary, to the President, if the effect of this so-called temporary measure and the more permanent measure for which it paves the way are to be averted.

Figures furnished to the American Scenic and Historic Preservation Society by United States engineers indicate that increased diversion of the water on the Canadian side in the years 1912-1916 lowered the water on the west end of the Horseshoe Fall more than a quarter of a foot, or to be exact, 0.26745 ft. Heaton's "Annual" for 1915, a Canadian

publication, states that the crest of the Canadian fall has been shortened 550 ft. since 1906. . . . It is evident that Niagara is in a precarious condition.

It is one thing to make measurements of water level accurate to 0.00001 of a foot; it is another and quite different thing to interpret correctly the physical causes that have produced the changes of which the measurements of water level are the index. The secretary of the Scenic and Historic Preservation Society *assumes* that the lowering of the water on the sides of the Horseshoe Fall is due to the increased diversion of water for power purposes on the Canadian side. In *Engineering News* of Dec. 14, 1916, however, John L. Harper, a well-known engineer, presented very convincing testimony indicating that the lessening of flow at the sides of the Horseshoe Fall is not due to the diversion of water from the river for power purposes, but to the rapid deepening of the river channel at the toe of the horseshoe by the vast volume of water now concentrated there. Elsewhere in the present issue of *Engineering News*, Isham Randolph, of Chicago, adds his testimony to confirm the soundness of Mr. Harper's diagnosis.

Even without the testimony of these well-known engineers it is easy for even an amateur in hydraulic engineering to see that there is something defective in Mr. Hall's assumption above quoted. The crest of the Horseshoe Fall is nearly 3000 ft. in length. It is true that diversion of water for power purposes on the Canadian side would not affect the depth equally over the entire length of the crest. The power-house intakes are far enough above the falls, however, so that increased diversion would certainly affect the depth a long way around the horseshoe. It seems very unlikely that increased use of water by the power plants on the Canadian side during the past four years while no new plants have been built can have diverted a volume of water so great as to account for the reduction of depth at the west end of the Horseshoe Fall which Mr. Hall states. It is entirely reasonable to believe, on the other hand, that the deepening of the river by the rapid erosion at the toe of the horseshoe, which is proceeding at an accelerating rate, is sufficient to account for a large part of the reduction in depth at the sides of the Horseshoe Fall.

The idea is too commonly held that the engineer is a materialist, interested solely in the utilitarian side of industry and having no appreciation of the beautiful in art and nature. It is our belief, on the contrary, that there is no body of men more generally appreciative of the beauty of landscapes and more generally interested in the preservation of natural scenery than are civil engineers. It is one of the compensations of the civil engineering profession to many of its followers that it gives them opportunity for outdoor life and the privilege of enjoying natural scenery to an extent impossible for a worker in an office or a shop. Mr. Hall will find a great number of engineers in hearty accord with his society, that the great cataract at Niagara must be preserved as a scenic spectacle. These engineers also realize, however, that this demand must be harmonized with the equally legitimate demand that the surplus power of the cataract shall be developed for public service. It is as important that men shall have the necessaries of life as that they shall be able to enjoy the beauties of nature, and enjoyment of the latter is impossible without the former.

The American Scenic and Historic Preservation Society has undertaken to protect Niagara Falls from destruction, but it can best accomplish this if it assumes a constructive instead of an obstructive attitude. The preservation of Niagara Falls as a grand world spectacle is a worthy object; but it is surely worth while to ascertain without prejudice the means by which that object can best be obtained, instead of concentrating every effort on opposition to the utilization of water from the falls, regardless of the extent to which such utilization may be responsible for changes in the cataract.

Hope for a Reform in the Conduct of Federal Public Works

"Sweet are the uses of adversity." So long as the national treasury was filled to overflowing and there was no fear of a deficit, engineers and others have urged in vain that the criminal waste of public money on worthless river and harbor projects should be stopped, and that a properly qualified commission should so control the expenditure and distribution of money for public works that the money would be spent only where the benefit to commerce justified it.

Again and again has this common sense and business-like method of dealing with our public works been advocated, in the halls of Congress and elsewhere; but the talk has vanished into thin air, and congressmen with importunate constituents to take care of have portioned out the river and harbor expenditures and the public building prizes in such a manner as their political power permitted.

This year, however, it is reported from Washington that President Wilson has served notice in advance on the congressional advocates of the $35,000,000 Public Buildings Bill and the $40,000,000 River and Harbor Bill that these omnibus distributions of pork shall not be made at this session if his veto can prevent it. Furthermore, he is reported to have declared that whatever money is to be spent on river and harbor work at a time when the Government faces an enormous deficit, must be spent on the recommendation of a competent commission which will deal with the matter from the national point of view and not from the local. If these reports prove true, and if the impending deficit actually brings about the establishment of businesslike methods in dealing with Federal public works, the deficit will be a profitable experience for the nation.

Another Valuable Concrete Fire Report

The Edison fire of two years ago was a highly educational catastrophe because of the thoroughness with which various technical bodies investigated the behavior of the reinforced-concrete buildings under such extreme heat conditions. Similar good results will flow from the warehouse fire of last November at Far Rockaway if wide distribution is assured of Mr. Woolson's admirable report of that structure, noted on another page of this issue. The Rockaway fire was decidely ominous in many ways. Respectful consideration of its lessons is imperative.

Letters to the Editor

Really Good New Year's Resolutions

Sir—It does not pay to make too many of them, but there are a few resolutions, which to make and keep, will do any of us a whole lot of good. So I do promise and swear: That I will read my copies of "Engineering News" within 24 hours after I get them. Furthermore, I am going to make it a point to look through the advertisements as carefully as through the reading matter, because I know there is a lot of "meat" there that is missed by most of us. One more, and I am through, for the fewer the resolutions, the more apt they are to be kept. Our stock in trade is knowledge. New books contain uptodate knowledge. So it is agreed to, by and with myself, that I will buy three new books every year. I have never spent money for books that I did not feel I had got my money's worth.

"MAKE A FEW RESOLUTIONS."

Albany, N. Y., Jan. 1, 1917.

Experiences of an "Examiner"

Sir—The comments of C. S. Merit in "Engineering News" Nov. 23, 1915, concerning the announcement by a civil service commission of an examination to fill the position of Civil Service Examiner in mechanical engineering, recalls this little poem from an old zoölogy:

The little fleas have smaller fleas
To worry 'em and bite 'em,
The smaller fleas have lesser fleas,
And so ad infinitum.

I am too firm a believer in civil service principles to hold it up to ridicule, yet no one can fail to see its serious shortcomings. As to passing examinations being the chief end of man, do we not meet every day men who are confirmed and habitual takers of examinations? I have come near to being in that class myself, but I believe that I have finally successfully sworn off. I have taken a great many United States examinations and one state examination and passed them all. In one case I was second on the list and there were to be three appointments. I have never heard from any of these examinations other than to receive my ratings and to know that I had passed and stood well up in the list. Although I am now a civil service employee, I was appointed prior to the passing of the civil service law and was confirmed without examination.

Civil service somewhat resembles socialism and single tax, in being a fine theory which no one has yet found a way to employ successfully in practice. C. S. VETERAN.

San Francisco, Calif., Dec. 8, 1916.

Protecting Automobile Traffic at Railway Grade Crossings

Sir—In "Engineering News" of Dec. 21 there are illustrated and described a number of plans suggested by the Railroad Commission of California to compel automobile traffic to slow up when passing over grade crossings so that proper caution may be exercised.

Permit me to suggest that a simpler and more effectual plan than any of those described is the placing of a hump in the roadway on each side of the crossing and 50 ft. or so distant. The hump should have a rounded contour and be of such a height and curvature that a car moving at low speed, six to eight miles an hour, will pass smoothly over it, but the automobilist who attempts to speed across it at 20 miles an hour or more will be taught a severe lesson. A gutter transverse to the roadway would serve of course as well as a hump, but would introduce difficulties in drainage, and cars would occasionally be stalled in it. There should, of course, be a prominent "slow" sign warning drivers not only of the crossing, but of the hump.

There has been much complaint in the last year or two of speeding motors breaking down guard gates at railway crossings. I suggest that an effectual cure for this practice of the speed maniac is the suspension from each gate of a strip of heavy canvas which, when the gate is down, will lie flat on the road. The canvas should be well studded with sharp brads projecting through it from the bottom side with their points up. If a still more savage punishment is wanted, attach a bar to the gate at such a height that it will strike the wind shield if the car runs into the gate when it is down. It might be objected that such an appliance would be too dangerous to install. This is probably true at a crossing as ordinarily arranged. If, however, an effective hump as above suggested is placed back of the crossing, the compulsory slowing up will make it certain that the driver who runs into the gate when it is down does so intentionally.

New York, Dec. 27, 1916. "SAFETY FIRST."

[In the article mentioned, it was stated that the grade check submitted by J. H. Weatherford, City Engineer of Memphis, Tenn., was a soft or retarding pavement on each side of the track. Mr. Weatherford advises us that what he recommended was to place a ridge or bump across the roadway, about 50 ft. from the tracks, exactly as recommended by "Safety First" above. The scheme has been used at grade crossings in the City Park roads at Memphis and has been tried at Los Angeles, as described in "Engineering News" of Sept. 7, p. 462.—Editor.]

Unwise Duplication of Transportation Facilities

Sir—In the midst of so much discussion concerning highway building and improvement, would it not be well to consider the relation improved highways may sustain to other facilities for transportation that may be already in existence?

Highway building and improvement will doubtless receive a decided stimulus by the recent action of Congress for coöperation between Federal and state authorities and through the spending of the $75,000,000 of Federal aid funds. Recognizing the beneficient influence of good roads upon the life of a community, I would be the last to hinder in any manner road improvement, but rather I would promote such enterprise by every legitimate means. However, attendance at a typical good-roads meeting of the local sort leads me to believe that those most strenuously urging promiscuous hard-road building are persons whose taxable property consists chiefly of an automobile. In fact, comparatively little attention appears to be devoted at such meetings to the consideration of the general community benefit.

To be most effective road improvement should be made after some comprehensive scheme. The plan most commonly suggested at present is that of trunk-line roads between large cities. This arrangement is intended primarily to accommodate pleasure driving and, it is said, freight hauling with motor trucks. A recent discussion in the technical press came to the writer's notice concerning the probable truck loads for which highways should be designed.

Is this an economical and effective procedure? The public already, by the payment of railroad rates, have built, at an enormous expense, facilities in the form of railroads for transporting passengers and freight between practically all cities of size in the country, and it is proposed to duplicate these transportation facilities by building highways at public expense that will conduct transportation in competition with them.

In a sense, the public is thus entering into competition with itself by constructing a second plant for performing the same service. Moreover, such a scheme accommodates the needs of a relatively small proportion of the population. It has been demonstrated by several writers recently that automobiles cannot conduct transportation as cheaply as can the railroad, even though their track (the highway) is furnished free. Even if they might do so by virtue of improved equipment and methods, rates or tolls charged the users of such proposed trunk line highways to cover the cost of road maintenance would be entirely logical.

Now would it not be a more rational procedure to build the highways as supplementary to the railways in the general scheme of transportation instead of spending public money

in paralleling them? The railways (steam and electric) together with the highways should constitute one great commercial circulatory system of the country, the railroads serving as the main arteries and veins and the highways as the capillaries, the latter distributing the passengers and commodities to their ultimate destinations.

The cost of transportation from consignor to consignee is dependent upon local haulage charges as well as upon freight rates, and funds might well be spent with a view to lowering the cost of local transportation in order that the entire cost of carriage may be a minimum. In other words, the highways should be planned primarily to care for local transportation, leaving to the railroads the trunk-line service between large centers of population.

Instead, therefore, of building the highways as competitors of the railways, they should be correlated with the railways in order that the whole may constitute a scientifically designed transportation system that will serve the general needs of the public most economically and most effectively.

C. C. WILLIAMS,
Professor of Railway Engineering and in charge of Highway Engineering, University of Kansas.

Lawrence, Kan., Dec. 21, 1916.

How To Save Horseshoe Fall at Niagara

Sir—In your issue of Dec. 14 is an article under the caption, "How To Save the Horseshoe Fall at Niagara," which was prompted by a paper of which John Lyell Harper is the author.

The subject discussed is one that has interested me for a long time past, as I have been familiar with the conditions at the falls for many years. For several years I was retained by the Queen Victoria Niagara Falls Park Commission as consulting engineer. I also acted in an advisory capacity for two of the power companies on the Canadian side and reported for the government of Ontario on the power situation at the falls and upon the possibilities of further development of power, both at the falls and from the rapids below.

During this long period of observation I have seen the Horseshoe Fall undergoing a transformation, gradually losing its U-shape and approaching a V-shape. I have seen the discharge over the limbs of this V lessening in depth and the descending sheet of water becoming more and more diaphanous while the torrent at the apex of the V became deeper, more voluminous and more destructive in its onrush to the abyss below.

I have seen this and realized that, unless something is done to arrest this destructive force, the beauty of the fall will deteriorate and the recession of the escarpment proceed with ever increasing rapidity.

I saw the importance, I might say the necessity, of diffusion works, and I evolved the method and the mechanical means of accomplishing the desired result.

When Mr. Taft was returning from Panama in February, 1909, aboard the armored cruiser "North Carolina," accompanied by the engineers of the commission which had gone with him to the Isthmus, I, as a member of that commission, had the privilege of daily intercourse with the then President-elect; and during that time I told him of conditions at the falls and of the remedy which I believed would arrest the destructive agencies that were at work. He was much interested and proffered his aid in bringing my plans before the Dominion Government.

I did not call upon him to make his offer good until 1911. Then he gave me a strong letter to the Minister of Finance, Mr. Fielding. This letter I presented to the Minister in Ottawa on Feb. 13, 1911. Mr. Fielding, after reading the letter, said: "My first question is, Is there any money in it for Canada?" I replied that there was, for by carrying out my plans the beauty of the falls would be preserved and a great volume of water now running to waste without producing beauty could be diverted from the falls—without detracting from either their grandeur or their beauty—and made to produce power.

He said that it was a question which really did not come within his province and gave me a letter to Dr. Pugsley, Minister of Public Works. When I laid my project before him, Dr. Pugsley sent for his engineering advisors, Louis Coste and A. St. Laurent, and instructed them to go fully into the subject with me and to report their conclusions to him. These gentlemen went fully into my plans with me and reported to the Minister of Public Works, whether verbally or in writing I do not know; but they both told me that their report was favorable.

Shortly after that the Laurier party was defeated, and the Borden party came into power. Since then I have made no effort to push my plans. They can only be carried through by coöperation between the Canadian Government and our own. Could they be carried out, the discharge over the whole rim of the falls could be made of a depth to produce the most beautiful effect; and the torrent which, unchecked—to borrow a simile from Mr. Harper—is so suicidal, would be diffused and rendered innocuous.

ISHAM RANDOLPH.
Continental Bank Building, Chicago, Ill., Dec. 27, 1916.

Sir—"Engineering News" of Dec. 14, 1916, p. 1135, contains an explanation of the apparent diminution of flow, with consequent lessening of the grandeur, of the Horseshoe Fall at Niagara. The author of the article suggests an "invisible" island to divert the main stream of water away from the narrow gorge that has been forming at the brink of the falls for several years.

This same idea has appealed to me, except that I should prefer a real island, not only visible, but accessible. To create such an island, I suggest a gang of cableways, say about four, from Goat Island to a point near the large gate-house on the Canadian shore about opposite the extreme upper end of Goat Island. Judging from the appearance of the rapids, the bottom of the river under these cables would be found to contain many large holes, or pockets, and I should try to drop into one of these holes one or more blocks of reinforced concrete. These might be made large enough to project above the water. They could be made very heavy by mixing scrap iron or iron ore in the aggregate, and this with the hold in the pocket would prevent them from being carried over the falls.

With this block or pile of blocks as a sort of breakwater, I should then sink a small casing in the more quiet water downstream therefrom and work to right and left, always downstream and to a predetermined outline, with casings, filling them with concrete and vertical rods. These casings should be comparatively small, say 12-in. pipes, sunk by well drills.

They should be sunk as close as possible along the outline of the island, and about twice that distance apart inside, over the entire area of the island. The island itself should be of solid concrete up to low-water level and treated, as to borders at least, with local stone above that level. A competent landscape architect could complete the island with soil, trees, etc.

The crux of the whole scheme would be the placing of the original breakwater, strong enough and heavy enough to withstand the terrific and continuous hammering of the rapids. It should of course be located at a point carefully selected to minimize the action of the water as much as possible. There are high points in the river bed, with pockets above and below, in which the energy of the water in the immediate vicinity is largely spent.

Conceivably, a barge could be designed which would approximately fit some particular hole in the river bed and which, when suitably anchored to the United States and the Dominion of Canada, could be filled from the cableway, even with pig lead, until even the Niagara River would not have enough grip on it to move it over the edge of the pocket selected.

The author of the previous article points out the desirability of this improvement on nature. Herein is submitted a suggestion as to its feasibility. There remains now the problem of finding someone to finance the job and of obtaining the consent of the Canadians and our own War Department to the obstruction of the river. Then the island may become a part of the world-famous scenery at Niagara Falls. There are many lighthouses, on remote and dangerous headlands and reefs, subject to fully as heavy a bombardment of water as this island would be, and nothing of the sort is impossible if it is determined to be worth the price.

IRA DYE.
76 Broad St., Newark, N. J., Dec. 18, 1916.

NOTES AND QUERIES

The Address of W. R. Rutledge (an electrical engineer who lived in Frankford, Canada, about 1906, but who left for work in the United States) is desired by Rinaldo McConnell, Kent Building, 156 Yonge St., Toronto.

Concrete Arch Bridge at Minneapolis—In the article describing the progress of work on the reinforced-concrete arch bridge over the Mississippi at Minneapolis, published in "Engineering News," Dec. 21, 1916, p. 1201, credit for the detail design of the structure should have been awarded to the Concrete Steel Engineering Co., of New York City.

Quartz-Gravel Aggregate Main Cause of Fire Damage to Concrete Building

The fire in the reinforced-concrete warehouse of Mullen & Buckley at Far Rockaway, N. Y., on Nov. 10, 1916, reported in *Engineering News*, Nov. 16, 1916, p. 936, was very important because of the curious distribution of the fire damage and of the serious destruction of the concrete under fire conditions of comparatively minor intensity. As pointed out in the article referred to, the spalling of the concrete in some sections was very great and in one end of one floor the concrete destruction had been so complete in certain members as to cause failure. That report was written only three days after the fire, when access to certain parts of the building was impossible. Since then an investigation of the structure has been made by Ira H. Woolson, Consulting Engineer to the Committee on Construction of Buildings of the National Board of Fire Underwriters, and his findings have been embodied in a report just issued. This report confirms most of the conclusions of the *Engineering News* report, but owing to greater facilities and time for observation, the Woolson report shows that structural failure was more widespread than was first thought. The report emphasizes the importance of the fire to those interested in the fire resistance of concrete buildings, points out some structural and fireproofing truths that are obvious from the fire and finally condemns the quartz-gravel aggregate as the secondary destructive agency in the concrete under fire.

Mr. Woolson specifies the fire damage and traces the probable entrance of the fire on each floor. Strangely enough the transmission from the initial fire next door to the first floor was probably through a 5-in. hole in the concrete wall, a hole used for a carrier system passage. In the ceiling above this hole was a 4-in. hole apparently left by the removal of a heating pipe. Through these two holes, through ½-in. openings alongside a poorly fitting fire-door, and through a 1-in. hole left from construction, the fire apparently spread from floor to floor, although even now there seems to be a possibility that one of the fire-doors separating the concrete building from the adjacent wood building where the fire started had been left open.

In structural damage, Mr. Woolson found considerable repetition of damage reported in the *Engineering News* article. All of this damage, however, is of like nature, that is the serious spalling of the concrete covering the reinforcement with consequent deflection or failure from structural weakness. The main conclusions of the report are as follows:

1. The one fact which stands out above all others in connection with this fire is that a suitable sprinkler system would have saved the concrete building with its contents and probably have controlled the fire in the frame building. It is one more demonstration of the folly of depending upon fire-resistive construction alone to protect inflammable contents of a building from fire. The owners had evidently made sincere effort to have a very safe structure. It was in general well built; wired glass windows were provided on all sides; the protection of vertical openings were standard; double approved fire doors were provided on communicating doorways; sets of fire pails properly filled were scattered about each floor, but were useless because of the smoke which entered the building preceding the fire. With all these precautions the building is today badly wrecked; a large proportion of the contents are ruined either by fire or water, and a total property loss of $125,000 or more has been sustained. Only a portion of this is covered by insurance and the business of the owners will be more or less paralyzed for many months. All this could have been saved by a comparatively small investment in sprinkler protection.

2. Although the area was not excessive, nevertheless it is quite apparent that had the floor space been divided by partitions of even moderate fire-resistive capacity the fire would have been localized and a large proportion of the damage prevented. In two stories—the fourth and seventh—plain pine board partitions held the fire from spreading until firemen were able to extinguish it.

3. The folly of erecting a high-grade fire-resistive building in all essential structural features and then allowing its efficiency to be ruined by permitting unprotected openings, even of small size, in walls and floors was strongly emphasized. The fact that fire was distributed from story to story by 3- and 4-in. pipe holes and that in at least one instance it was transmitted through a 1-in. hole in a fire wall indicates the extreme care and ferret-like inquisitiveness which insurance inspectors must exercise if they furnish their companies with complete and reliable estimates of the fire hazards which exist in a building.

DAMAGE VERY GREAT FOR APPARENT FIRE

4. So far as the reinforced-concrete building itself is concerned, the most impressive feature of its appearance is the extent of the damage done, which seems to be quite disproportionate to the severity of the fire. With the exception of the exterior south wall, exposed to the adjoining burning building, and a portion of the third story, where a few barrels of oil and other inflammable liquids were burned, there were no indications of very hot or long-continued fire. In the areas covered by the two exceptions all combustible material was consumed, and there is evidence of fairly high temperature, probably 2000° F. In all other places where fires occurred, it is plainly to be seen that they were flash surface fires of short duration. They were extinguished before attacking surrounding material, and yet the damage to the concrete was severe.

5. The Edison plant fire, and fires elsewhere in reinforced-concrete structures, have taught us that the rapid surface expansion of concrete when subjected to a quick fire is destructive to structural members with sharp corners. Square columns and beams should, therefore, be avoided. Inspection of the photographs will show that the columns and girders in this building were beveled, but it was not enough to be of real service. This is another important lesson emphasized by this fire. Only round columns, or those closely approaching that shape, should be used on the interior of a building.

BEAM REINFORCEMENT SHOULD BE PROTECTED

6. The safety of beams is scarcely less vital than columns, but it is difficult to round them sufficiently to avoid spalling and at the same time properly protect the reinforcing bars. This difficulty can be overcome by using some form of mesh reinforcement surrounding the main reinforcement bars on the bottom and supported by them, similar to the methods employed to hold concrete fireproofing on steel I-beams. The added cost would be slight and the increased security when attacked by fire would be very material. Perhaps the best solution of the problem may be found in the elimination of beams entirely and using flat-slab construction. Unfortunately this form of construction is comparatively new, and we have not as yet secured sufficient testimony regarding its behavior when attacked by fire to judge its merits as a fire-resistant as compared with the older forms of construction.

7. A certain amount of the damage which ensued in this building can justly be credited to improper shape of structural members, and doubtless some of it may be explained by the fact that water was thrown upon the concrete while hot. The deficient concrete protection to the reinforcement probably also contributed to the failure; however, considering the freedom with which the concrete spalled from the reinforcement bars, it is questionable whether a thicker protection of this concrete would have rendered more efficient service. This excessive spalling seems inconsistent with what past performance has taught us to expect, especially when we consider the moderate fire which produced it, and we are extremely loath to believe that all concrete would exhibit the same weakness under like conditions.

The concrete itself appears to be good. Where not disintegrated by heat it is clean and dense. What then was the trouble? In the writer's opinion it was the use of quartz gravel for the coarse aggregate.

During the years 1905, 1906 and 1907 the writer conducted an "Investigation of the Thermal Conductivity of Concrete Mixtures, and the Effect of Heat Upon Their Strength and Elastic Properties." This work was done for the American Society for Testing Materials, and the final report was pub-

lished in the Society Proceedings for 1907. In this he said:

Although the thermal conductivity of the gravel concrete was fully as low as that of the trap, it must nevertheless be condemned as a first-class fire-resisting mixture. All the specimens of gravel concrete tested were badly disintegrated by the heat. The gravel specimens would crack and crumble in pieces when the trap and cinder specimens under similar treatment would remain firm and compact. The writer is convinced that concrete made from this particular gravel is not reliable as a fire-resisting material. Whether other grades of gravel would give equally unsatisfactory results is a matter for investigation.

The cause for this failure of the quartz mixture is not easy to locate. The most plausible reason seems to be the relatively large coefficient of expansion of the quartz. It is about twice that of feldspar, which is one of the predominant minerals in trap rock. Clark's "Constants of Nature," published by the Smithsonian Institution, gives the cubical coefficient of expansion for these minerals as follows:

Quartz ..... 0.000036 Feldspar 0.000017

According to the same authority, quartz has another peculiarity of expansion, namely, that the expansion in the direction of the major axis is only half that in the direction of the axis perpendicular to the major axis. This unequal expansion may further contribute to its tendency to disintegrate the concrete under action of heat.

Since the distribution of gravel is much more general than trap, the subject is of much importance, and tests should be made to determine if other gravels are equally defective.

Also one of the conclusions in the "Summary" o that report was "That the gravel concrete was not a reliable or safe fire-resisting aggregate."

The behavior of the concrete in this fire appears to confirm the criticism above mentioned.

If this explanation is correct, as evidence thus far produced seems to sanction, all concrete specifications should contain a definite warning against the use of quartz gravel in concrete liable to be exposed to high heat. Where it is so used, underwriters should take that fact into account when assuming the risk.

WHY QUARTZ-GRAVEL IS POOR AGGREGATE

It should be stated that the weakness of quartz-gravel concrete is due to a general disintegration of the mass, and not, as might be supposed, to fracture of the pebbles themselves. Very few broken pebbles are found in such ruptured concrete. Quartz pebbles are usually made up of a mass of interlocking crystals, and although the unequal expansion of these crystals along their axes is microscopical in character, it can easily be conceived that each pebble when highly heated would be subject to numerous unbalanced internal expansion stresses tending to produce an agitation of the surface of the pebble which would contribute to breaking the bond between the pebble and the mortar in which it was embedded. Some evidence produced seems to indicate this, but the extent of such action is of course purely speculative. It may be found that the smooth surface of the gravel is the principal cause of weakness, though some tests upon concrete made of gravel other than quartz would not imply this.

Whatever the deteriorating cause or causes may be, it is quite certain that evidence thus far at hand is prejudicial to quartz-gravel concrete liable to be subject to fire. The matter is one of great importance to the concrete industry, and a complete investigation of the problems involved should be made by some qualified scientific authority.

Boston's High-Pressure Fire Service an Example of Municipal Inefficiency

Over five years have elapsed since the work of designing the Boston high-pressure fire-service system was undertaken, and from conservative estimates it will be two years more before a very necessary pumping station can be put into service, says the report recently issued by the National Board of Fire Underwriters. Because of delays, changes of plan, indecision and inefficiency on the part of the city administration, engineering expenses will be about double those customarily found in such enterprises. The report states:

Contracts have not been favorable to the city and have been poorly and expensively carried out. The continued delay and changing of plans have resulted in materially increasing the cost of the work which now has to be done to complete the system. With the low prices of labor and materials prevailing between 1911 and 1914, it is believed that the originally planned system could have been completed within the appropriation, but under the present conditions this is obviously impossible. Because of the evident insufficiency of the present available funds to complete the system, the city is contemplating the construction and equipment of a pumping station which will be below the desired standard and will serve a system at present less than half as complete as is necessary.

VICISSITUDES OF THE PROJECT

Briefly, the history of the project is this: The construction of a $1,000,000 high-pressure fire-service system was authorized in August, 1911, after the deficiencies of the existing fire service had been strongly urged by the Fire Prevention Committee of the National Board of Fire Underwriters. Plans and specifications for the construction of the distribution system and of the pumping-station equipment were submitted to the committee for approval in 1912.

The proposed system was to consist of 2.5 mi. of supply mains from the pumping station to a gridiron system of 14.3 mi. of mains 12 to 20 in. in diameter, protecting 550 acres in the congested district. The pumping station was to have a capacity of 18,000 gal. per min. at 300 lb. pressure.

In 1913 contracts were let for most of the materials, and deliveries were made. At the same time a hitch occurred over the location of the pumping station. Seven or eight proposed locations were suggested and rejected for various reasons during 1914, involving a large amount of ultimately useless surveying and planning as well as some trenching that had to be filled in again without accomplishing anything. Pipe laying was commenced in August, 1914, and 4 mi. of pipe was laid. Of this the report states:

The workmanship on this part of the contract was inferior, and great trouble was experienced in making the contractor comply with the specifications. A report of the engineer in charge, made to the Commissioner of Public Works through the division engineer on Jan. 20, 1915, called attention to much of this inferior workmanship, particularly in the manner of making and calking the joints. Competent men were not employed by the contractor in this work, and many of the tools required were not found on the job, much less used. Because of these conditions, the system did not meet the leakage-test requirements, and the engineer in charge refused to accept the lines laid and recommended uncovering and recalking the sections showing high leakage. Much of this has been done, as brought out later in this report.

. . . . . .

On Nov. 20, 1916, Clarence Goldsmith, an engineer lent by the Board of Fire Underwriters to take charge of the installation, who had refused, except in one instance, to approve any of the monthly estimates for payments on the pipe-laying contract because of the failure to meet contract requirements, was summarily dismissed from his position.

JOINTS FILLED WITH SPECIAL ALLOY—WORK POORLY DONE

Because of the crowded condition of underground structures, making it impossible in many instances to obtain the necessary clearance, it was decided to abandon the usual practice in such work of tying in bends and hydrant branches with lugs and steel tie-rods, and to depend upon a stronger joint by using an alloy of lead (developed after a series of tests). This alloy consisted of lead, tin and antimony, and under test gave a stronger joint than a plain lead joint and tie-rods, for the sizes of pipe used.

The original specifications called for a leakage not to exceed ½ gal. per lin.ft. of joint per 24 hr., but, due to poor calking, this allowance was not attained, and the requirement was raised to 4 gal., or about double that allowed on any similar system. Even with this new requirement, many sections laid in the first contract failed

to meet the specifications. During the spring and summer of 1916 many of these joints were uncovered and recalked, and at the present time most of the sections have a leakage under 400 lb. pressure of less than 4 gal. per lin.ft. of pipe joint per 24 hr. The maximum is 5.39 gal. and the average about 2.8 gal. For the total 6 mi. laid this corresponds to a total of 46,900 gal. per 24 hr. or 33 gal. per min.

Much Remains To Be Done

The report states that it is very evident that the City of Boston is in need of the service available from a modern, well-equipped and well-designed and powerful high-pressure fire-service system and that such a system has not yet been provided, although ample time has been consumed in its construction. This has been responsible in part for a wasteful expenditure of the funds available; and to finish the system to the degree necessary for the protection desired, additional funds must be provided.

It is recommended that a site for the pumping station be decided upon at once and a plant provided which will have an ultimate capacity of 24,400 gal. per min.; that the plant be designed so as not to depend on a single suction or discharge line and that it be connected to the system by three independent 20-in. mains; that the duplex system, as originally contemplated, be completed; that the system be tested under 300 lb. pressure for 24-hr. periods, at least monthly, to study leakage and develop weak joints, and that in the future more care be taken to follow the specifications.

The new system, or the part of it which is completed, is at present connected to two older high-pressure services by 16-in. mains, which give a pressure of only about 90 lb. at the hydrants.

News of the Engineering World

Progress of Ontario Hydro-Electric Commission Power Plans

The scheme for the development of additional electric power by the Ontario Hydro-Electric Commission at Chippawa Creek in the Niagara district, as noted in *Engineering News*, Nov. 30, 1916, was formally approved on Jan. 1 by the voters in 10 cities and 36 towns and villages of western Ontario. The following question was submitted:

Are you in favor of having the municipality develop or acquire through the Hydro-Electric Power Commission of Ontario whatever works may be required for the supply of electric energy or power, in addition to such electric power as is already obtained under the existing contract with the Hydro-Electric Power Commission of Ontario?

The only adverse vote was that of the town of Goderich. This referendum was taken because of the criticism that the government had no mandate from the people for the expenditure of the large sum involved. Legislation will be introduced at the approaching session of the provincial legislature authorizing municipalities to contract for the development with the Hydro-Electric Commission, and to assume their shares of expense.

On Jan. 1, referendums were taken in interested municipalities on the "hydro-radial" railway from Port Credit to St. Catharines, a project to cost $11,360,000. It was widely approved, but was defeated in Hamilton, which would have been liable for bonds to the amount of $5,869,000. The project will not be abandoned.

Associated Societies of Baltimore

The several engineering and technical societies of Baltimore have been combined in one organization, known as the Associated Technical Societies of Baltimore. The committee which framed the prospectus of the association was composed of W. W. Pagon, representing the Engineers' Club of Baltimore, and the Baltimore section of the American Society of Civil Engineers, John B. Whitehead, American Institute of Electrical Engineers, E. E. Reid, American Chemical Society, Professor Christie, American Society of Mechanical Engineers, Clyde Friz, American Institute of Architects, Percy Nicholson, American Society of Marine Draughtsmen, and G. J. Requardt, representing the alumni societies jointly. The associated membership numbers between 500 and 600. The tentative draft of the articles of association define the society organization as follows:

The governing body shall be a board of governors which shall consist of the presidents of the member organizations.

The officers shall consist of a chairman, vice-chairman and an executive secretary-treasurer to be elected by the board of governors.

Power shall rest in the board of governors to determine what constitute matters of policy, but the board of governors shall exercise decisive power as to all matters of purely routine organization questions. A majority of the board of governors shall constitute a quorum.

The chairman and vice-chairman shall be elected from the board of governors and shall hold office for the term of one year, or until their successors on the board are elected by the respective organizations. The secretary-treasurer shall belong to one of the member organizations, but need not be a member of the board of governors. His term of office shall be for a period of one year or until his successor is elected.

Dues shall be paid by the member organizations in proportion to their respective memberships and where individuals are connected with more than one member organization the per capita dues shall be paid equally by such organizations.

School for Army Engineers Reserve Corps Started in New York

A school for officers (and applicants) of the United States Army Engineers Reserve Corps was started in New York City on Jan. 3, by the joint military-engineering committee of the national engineering societies. This school has been organized on the authorization of Gen. W. M. Black, Chief of Engineers, U. S. Army, and with the approval of Gen. Leonard Wood, commanding the Department of the East. The school will be in charge of Capt. T. M. Robins, and he will be assisted by Captains E. D. Ardery, R. G. Alexander and L. C. Herkness, Corps of Engineers, and by

non-commissioned officers detailed from the Washington Engineer Barracks and West Point Engineer Detachment.

The school will meet for drill once a week (generally Wednesday nights) during the winter; outdoor work will be taken up in the spring. The weekly sessions will be given up to infantry and engineer drill, officers' schools, lectures and assigned problems. Methods used at the Military Academy will be followed; the early work will be intended to show how the reserve officers would have to proceed in organizing new engineer companies.

The New Orleans Bridge or Tunnel project has progressed a step by the state vote of Nov. 7, which authorizes an amendment of the Louisiana constitution permitting the City of New Orleans to construct a bridge over or a tunnel under the Mississippi River at that city. The vote was 26,189 for and 6,223 against.

A Manhole Explosion in the Edison conduits in South Boston, Mass., on Jan. 1 killed one person and injured a number of others. Examination revealed two leaks in a 4-in. gas main at the corner of L and East Third St. The pipes, said to be 20 years old, were uncovered by the Boston Consolfdated Gas Co. and temporarily patched. The Edison Electric Illuminating Co. states that none of its circuits was broken by the explosion.

Agitation for a Street Tunnel on Second St., Los Angeles, Calif., is being pushed by an association of property owners. The tunnel was located and designed by the city a year or two ago, but no decision has been reached concerning its construction. It is planned to connect Hill St. with Clay St.; the tunnel width is to be 50 ft., so as to accommodate street-car tracks as well as ample vehicle driveways. The Second St. Tunnel Association, 331 West Second St., is now backing the project.

A Third New Railway Station at Buffalo is presaged in the approval by the Terminal Commission of plans for a new passenger and freight terminal for the New York Central Lines. The Lehigh Valley R.R. is already in its new station and that for the Lackawanna is fast approaching completion. All three of these stations are within an area of four blocks and the New York Central being immediately alongside of the Lehigh Valley. This new station will be on the site of the old, that is, extending along Exchange St. from Washington to Michigan St., and will have full passenger and freight accommodations. Public hearings are to be held on the design in the early part of the year.

Reconstruction of Lyman Dam, Arizona—The failure of Lyman dam, near St. Johns, Ariz., was discussed in "Engineering News," Apr. 22, 1915, p. 794, a brief description of the dam and reservoir being given at the same time. The reconstruction and safeguarding of this dam have recently been intrusted to the Field, Fellows & Hinderlider Engineering Co., Denver, Colo., the work to be done under the personal supervision of M. C. Hinderlider, of that company. The reservoir, the second largest in the State of Arizona, being next in size to the Roosevelt reservoir, is owned by the Lyman Land Co. The estimated cost of reconstruction is $100,000. The work contemplated includes, in the main, trenching to bedrock, the placing of about 220,000 cu.yd. of earth by hydraulicking it into place and laying a heavy surfacing of riprap.

Engineering Work on the "Eagles' Nest" Irrigation Project of the Cimarron Valley Land Co., Cimarron, N. M., has been placed in the hands of Bartlett & Ranney, Inc., Consulting Engineers, Dallas and San Antonio, Tex. This project is located in Colfax County, New Mexico, and includes the construction of a large storage dam and reservoir with a diversion dam on the Cimarron River, 30 mi. below the reservoir, and usual canal and irrigation structures for irrigating 30,000 acres of land. Construction of the "Eagles' Nest" storage dam, which is to be an arched masonry structure 140 ft. high on a radius of 155 ft., has been started. The dam is located in a granite gorge of the river at an elevation of over 8000 ft. above sea level. Neal Hanson is Supervising Engineer and A. P. Rollins is Assistant Engineer.

Substantial Progress on the Flood-Prevention Project on the rivers of Kansas and the adjoining states is being made, according to a report from the Engineering Committee of the Kansas Flood and Water Congress. The Federal River and Harbor Bill of July, 1916, provided for an examination by the War Department of the flood periods of the Kansas River and its tributaries, the Cottonwood and the Neosho Rivers, and for the development of a plan for flood prevention and protection. The Chief of Engineers assigned this duty to Colonel McD. Townsend, Corps of Engineers, U. S. A., who visited the state and held several conferences with the Engineering Committee and other members of the congress. He then directed Percival Churchill, United States Assistant Engineer, to represent him and to make a personal investigation of the territory under consideration. Mr. Churchill has been in Kansas since the last of November, has traveled over most of the more important streams, examined obstructions, bank erosions, existing works, many proposed reservoir sites and has collected miscellaneous data relating to various phases of the problem. It is understood that he will soon make a preliminary report to Colonel Townsend, outlining a future course of action. It is also expected that he will follow this by a thorough examination, based on this preliminary report.

PERSONALS

Croxby J. McGiffert, formerly Assistant Town Engineer of Montclair, N. J., has been appointed Acting Town Engineer, succeeding Edgar S. Closson.

A. A. Cook, formerly with the engineering corps of the Central R.R. of New Jersey, has been appointed Recorder of Deeds of Mauch Chunk, Penn.

George Mercer, General Foreman of Bridges and Buildings of the Duluth, South Shore & Atlantic Ry., has been appointed Superintendent of Bridges and Buildings.

C. R. Harding, formerly Chief Draftsman of the Southern Pacific Co., New York City, has been promoted to be Assistant Consulting Engineer, with office at New York.

Joseph R. Greenwood has resigned as General Manager of the Ballwood Co., and is now associated with Charles H. Higgins, Architect and Engineer, 30 Church St., New York City.

R. S. Clear, Assistant Engineer of the Duluth, South Shore & Atlantic Ry., Duluth, Minn., has been promoted to be Office Engineer, succeeding J. E. Bebb, resigned, as noted elsewhere.

Frank Helm, Office Engineer of the Atchison, Topeka & Santa Fe Ry., Western lines, Northern district, at La Junta, Colo., has been promoted to be Division Engineer at Slaton, Tex.

E. S. Shuler has been appointed City Manager of Sumter, S. C., succeeding L. E. White, resigned. Sumter was one of the earliest cities to adopt the city-manager form of government.

S. J. Mans, Office Engineer of the Missouri, Kansas & Texas Ry. at St. Louis, Mo., has resigned to become Resident Engineer of the Galveston, Houston & Henderson R.R., with office at Galveston, Tex.

A. Pearson Hoover, Assoc. M. Am. Soc. C. E., formerly Contracting Engineer for the John W. Ferguson Co., Paterson, N. J., is now associated with E. P. Goodrich, Consulting Engineer, New York City.

Ross McClave, of McClave & McClave, Consulting Engineers, New York City, has been appointed County Engineer of Bergen County, New Jersey, succeeding Henry Welles Durham, as noted elsewhere.

W. Watters Pagon, M. Am. Soc. C. E., recently associated with J. E. Greiner & Co., Consulting Engineers, Baltimore, Md., has opened an office at 1218 Fidelity Building, Baltimore, for general practice of structural engineering.

George W. Knopf announces that he has opened offices at 302 Pennsylvania Building, Philadelphia, Penn., for the practice of consulting engineering, specializing in the design and construction of complete industrial plants.

Dr. Herman M. Biggs, State Health Commissioner of New York, is to go to France soon, under the auspices of the Rockefeller Foundation, to conduct a campaign against the spread of tuberculosis among noncombatants.

F. W. Bailey, recently Resident Engineer of the Galveston, Houston & Henderson R.R., Galveston, Tex., has been appointed Engineer of Maintenance-of-Way of the San Antonio & Aransas Pass Ry., with headquarters at Yoakum, Tex.

F. R. Hesser, formerly Assistant Engineer of the Kansas State Board of Health, Lawrence, Kan., and recently with the General Fireproofing Co., Youngstown, Ohio, is now Senior Engineer of the Fireproof Products Co., New York City.

Henry Goldmark, M. Am. Soc. C. E., Consulting Engineer, New York City, has been appointed a member of the Board of Consulting Engineers for the New York State Barge Canal, to fill the vacancy caused by the death of Dr. Elmer E. Corthell.

R. B. Clapp, formerly with the Pennsylvania Water and Power Co., Baltimore, Md., has been appointed District Manager of the Andrews Bradshaw Co., steam-plant equipment manufacturers, of Pittsburgh, Penn., with offices at Cleveland, Ohio.

Max R. Hall, of the firm of Hall Brothers, Consulting Engineers, Atlanta, Ga., has been appointed Assistant Chief of

Construction for the City of Atlanta. The firm of Hall Brothers now consists of B. M. Hall, M. Am. Soc. C. E., and B. M. Hall, Jr.

R. E. McCarty, General Superintendent of the Pennsylvania Lines West of Pittsburgh, with headquarters at Columbus, Ohio, has been elected Resident Vice-President at Detroit, Mich. He began his railway career in 1879 as a telegraph operator.

H. Malcolm Pirnie, Assoc. M. Am. Soc. C. E., has been admitted to the firm of Hazen, Whipple & Fuller, Consulting Civil Engineers, New York City. He is a graduate in sanitary engineering of Harvard University and has been with the firm since 1912.

R. W. Newton, Assistant Deputy Engineer of the Minnesota State Highway Commission, has been appointed Road Engineer of St. Louis County, Minn., at a salary of $4500 a year. His headquarters are at Duluth. The county will spend $800,000 on road work in 1917.

R. S. Whiting, of Grand Rapids, Mich., formerly an architect of Boston, Mass., has joined the staff of the Trade Extension Department of the National Lumber Manufacturers Association, Chicago, Ill., and will have charge of work along technical and engineering lines.

F. T. Hatch, M. Am. Soc. C. E., Chief Engineer of the Vandalia R.R., St. Louis, Mo., by a change in scheme of organization of the company, has been appointed Chief Engineer of Maintenance-of-Way of the St. Louis system of the Pennsylvania Lines West of Pittsburgh.

R. C. White, Assoc. M. Am. Soc. C. E., Engineer of Maintenance-of-Way of the Missouri Pacific Ry., at Little Rock, Ark, has been promoted to be Superintendent of the Memphis division, with office at Wynne, Ark. Prior to April, 1914, he was Roadmaster of this division.

J. H. Nead, formerly Metallurgist and Engineer of Tests at the Watertown Arsenal, Watertown, Mass., has been appointed Metallurgical Engineer of the Minneapolis Steel and Machinery Co., Minneapolis, Minn. He is a mechanical engineering graduate of the University of Michigan, class of 1909.

Chester Harding, M. Am. Soc. C. E., Lieutenant-Colonel, Corps of Engineers, U. S. A., has been appointed Governor of the Panama Canal, to succeed Maj.-Gen. George W. Goethals, who recently resigned. Lieutenant-Colonel Harding has been Acting Governor for some time. He has been connected with the Panama Canal work since 1906.

A. L. Baldwin, Assistant Chief of the Division of Geodesy, United States Coast and Geodetic Survey, Washington, D. C., has resigned to become General Agent of the Northwestern Mutual Life Insurance Co. for the Washington district. Mr. Baldwin entered the Survey as an aid and after several years of field work he joined the office force as a computer. Mr. Baldwin was recently elected President of the Washington Society of Engineers.

A. R. Young, Assoc. M. Am. Soc. C. E., City Engineer of Topeka, Kan., for the past six years, has resigned, effective Feb. 1, to become Manager of the service department of the Western offices of the John Baker, Jr., Asphalt Distributing Co., of Chicago, Ill. Mr. Young was graduated from the University of Kansas in 1905, and was formerly in the engineering department of the Atchison, Topeka & Santa Fe Ry. at Chanute, Kan. From 1908 to 1910 he was City Engineer of Chanute, going from there to Topeka.

Wilbur J. Watson & Co. announce the formation of the Watson Co., Engineers, Cleveland, Ohio. The personnel of the new company includes: **Wilbur J. Watson,** M. Am. Soc. C. E., President and Chief Engineer; **W. P. Brown,** M. Am. Soc. C. E., Vice-President and Principal Assistant Engineer; **F. L. Gorman,** Designing Engineer; **R. S. Ferguson,** Construction Engineer; **N. H. Hick,** Building Engineer; **H. R. Hadlow,** Mechanical Engineer; **A. M. Felgate, W. J. Wefel** and **E. W. Bowen,** Assistant Engineers, and **H. H. Smith,** Inspecting Engineer.

T. B. Hamilton, recently General Manager of the Vandalia R.R., at St. Louis, Mo., has been chosen Resident Vice-President of St. Louis system of the Pennsylvania Lines West of Pittsburgh. The Vandalia R.R., long a subsidiary of the Pennsylvania R.R., is now operated as a part of the Pennsylvania Co., instead of independently. Mr. Hamilton is a graduate of Princeton University, class of 1888, and began his railway experience the same year as a rodman on the Jeffersonville, Madison & Indianapolis Ry. at Louisville. He remained in the engineering departments of the various subsidiaries of the Pennsylvania lines until 1903, during which time he served as Engineer of Maintenance-of-Way on three divisions. He then became Division Superintendent of the Erie & Ashtabula division, and later General Superintendent of the Central system of the Pennsylvania Lines West of Pittsburgh.

William M. Acheson has resigned as Division Engineer, New York State Highway Department, Division 6, to become Chief Engineer of the Crescent Portland Cement Co., Wampum, Penn. He was educated at Rensselaer Polytechnic Institute and Union University. He entered the employ of the Troy Water-Works Department in 1900 as a chainman. Two years later he was placed in charge of construction of the Quackenkill diverting dam. In 1904 he joined the engineering staff of the Panama Canal as a leveler. Subsequently he was promoted to be Acting Resident Engineer in the Bureau of Municipal Engineering and Engineer in charge of the Third district of the Pacific division, which included the Bureaus of Municipal, Sanitary Engineering and Building Construction. He left the Canal Zone in 1910 to become Supervising Engineer of the County Construction Co. in New York State. In October, 1913, he was appointed Division Engineer, New York State Highway Department.

Albert W. Newton, M. Am. Soc. C. E., Assistant to the President of the Chicago, Burlington & Quincy R.R., has been appointed Chief Engineer to succeed the late T. E. Calvert. He was born in Illinois. He was in general engineering practice from 1892 to 1900 in the Central West. His first railway experience was with the Chicago & Alton Ry. as Assistant Engineer in 1900. He joined the engineering staff of the Chicago, Burlington & Quincy R.R. in 1903 as Construction Engineer at St. Louis, Mo., in charge of the Monroe, Mo., to Mexico extension. In 1907 he was appointed General Inspector of Permanent Way and Structures in the office of the Vice-President at Chicago, Ill. For a few months in 1908 and 1909 he was Acting Division Superintendent at Creston, Iowa. In 1914 he was appointed Chairman of the Federal valuation committee of the C., B. & Q., and also Chairman of the engineering committee of the Western Group Presidents' Conference Committee on Federal Valuation. He retains both these offices.

Henry Welles Durham, M. Am. Soc. C. E., has been forced out of the office of County Engineer of Bergen County, New Jersey, by local politics. Mr. Durham was formerly Chief Engineer of the Bureau of Highways of the Borough of Manhattan, New York City. He was appointed County Engineer of Bergen County, New Jersey, in December, 1915. He had the misfortune to be a member of the Seventh Regiment, New York National Guard, and spent several months away from his office during the past year. The recent election changed the complexion of the County Board of Freeholders and great stress was laid upon the fact that Mr. Durham had not been a resident of the county before his appointment. One member of the board paid the following tribute to Mr. Durham's services: "Bergen County will suffer a serious loss if the Board of Freeholders dispenses with the services of Henry Welles Durham, the County Engineer, who has made good. The history of the engineer's office since he took charge a year ago has been one of efficiency, economy and splendid work." Another member of the Board said: "A man who has done as County Engineer what Mr. Durham has done must of necessity have made bitter enemies, and these enemies are the best proofs of duty well performed. The enmities he has aroused by his unrelenting opposition to crooked methods in the county road department make me all the more anxious to stand by him. I cannot bring myself to think that a majority of the Board of Freeholders elected to protect the taxpayers against looting and grafting will vote next Monday against the County Engineer who has done so much to help carry out the policies to which the Board was pledged. I hope those policies will not now give way to peanut politics." Mr. Durham will devote his whole time to private practice, with offices at 366 Fifth Ave., New York City.

OBITUARY

Edward L. Peene, Superintendent of the Water Bureau of Yonkers, N. Y., died Dec. 31, from pneumonia.

Sanford Horton, who had a part in the construction of some of the railways in Mexico, died Jan. 4, at his home in Continentalville, N. Y., aged 58 years.

Fred Walters, City Engineer of Manhattan, Kan., since 1912, was killed in an automobile accident near Manhattan on Dec. 9. He was a civil engineering graduate of the Kansas State Agricultural College.

Andy Brann, for 15 years senior member of the firm of Brann & Stuart, Engineers and Contractors, Philadelphia, Penn., died Jan. 5, at his home in that city. He was born in Ohio in 1849. He was connected with the construction of the famous Eads bridge over the Mississippi at St. Louis, Long bridge over the Potomac at Washington, D. C., the trainshed

of the Broad St. station, Philadelphia, and other notable structures.

James Skene, a railroad contractor, died Dec. 23 from pneumonia, at Seneca, S. C., where he was doing some work for the Southern Ry. He was born in Scotland and came to this country as a young man. He was well known in the West as a bridge contractor, having erected bridges over the Missouri and Rio Grande Rivers. He also had a part in the construction of the Queen & Crescent bridge over the Kentucky River. He was 71 years old and survived by three sons and two daughters.

ENGINEERING SOCIETIES

SOCIETY OF AUTOMOTIVE ENGINEERS.
Jan. 11. Annual meeting in New York City. Secy., C. F. Clarkson, 129 West 39th St., New York.

COMPRESSED GAS MANUFACTURERS' ASSOCIATION.
Jan. 15. Fourth annual meeting in New York City. Secy., O. S. King, 120 Broadway, New York.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 17-18. Annual meeting at Society House, New York City. Secy., Charles Warren Hunt, New York.

INDIANA ENGINEERING SOCIETY.
Jan. 18-19. Annual meeting in La Fayette, Ind. Secy., Charles Brossmann, 1616 Merchants' Bank Bldg., Indianapolis.

WESTERN BRICK MANUFACTURERS' ASSOCIATION.
Jan. 20. Meeting in Kansas City, Mo. Secy., G. W. Thurston, 416 Dwight Building, Kansas City.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 23-25. Annual meeting in Montreal, Can. Secy., C. H. McLeod, 176 Mansfield St., Montreal.

ILLINOIS SOCIETY OF ENGINEERS.
Jan. 25-26. At Chicago. Secy., E. E. R. Tratman, Wheaton, Ill.

NORTH DAKOTA SOCIETY OF ENGINEERS.
Jan. 30-31. Annual meeting in Bismarck. Secy., E. F. Chandler, University, N. D.

OHIO ENGINEERING SOCIETY.
Jan. 31-Feb. 2. Annual meeting. Ohio State University, Columbus, Ohio. Secy., John Laylin, Norwalk, Ohio.

AMERICAN ROAD BUILDERS' ASSOCIATION.
Feb. 5-9. Eighth National Good Roads Show, in Boston, Mass. Secy., E. L. Powers, 150 Nassau St., New York City.

NATIONAL LIME MANUFACTURERS' ASSOCIATION.
Feb. 6-7. Annual meeting in New York City. Secy., F. K. Irvine, 537 South Dearborn St., Chicago.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Feb. 7-9. Midwinter convention in New York City. Secy., F. J. Hutchinson, 33 West 39th St., New York City.

MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY.
Feb. 7-9. Annual meeting in Minneapolis.

TENTH CHICAGO CEMENT SHOW.
Feb. 7-15. In Chicago. Under management of Cement Products Exhibition Co., 210 South La Salle St., Chicago.

AMERICAN CONCRETE INSTITUTE.
Feb. 8-10. In Chicago at La Salle. Secy., H. D. Hynds, 30 Broad St., N. Y.

NATIONAL BUILDERS' SUPPLY ASSOCIATION.
Feb. 12-13. In Chicago at Sherman. Secy., L. F. Desmond, 1211 Chamber of Commerce, Chicago.

INDIANA SANITARY AND WATER-SUPPLY ASSOCIATION.
Feb. 14-15. Annual meeting in Indianapolis. Secy., W. F. King, Indianapolis, Ind.

WISCONSIN ENGINEERING SOCIETY.
Feb. 15-16. At Madison, Wis. Secy., L. S. Smith, 939 University Ave., Madison, Wis.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 19-22. Meeting in New York City. Secy., Bradley, Stoughton, 29 W. 39th St., New York City.

SOUTHWESTERN CONCRETE ASSOCIATION.
Feb. 19-24. Southwestern Concrete Show in Kansas City, Mo. Address Chas. A. Stevenson, 1413 W. 10th St., Kansas City.

IOWA ENGINEERING SOCIETY.
Feb. 21-23. Annual meeting in Ames. Secy., J. H. Dunlap, Iowa City.

The Franklin Institute will hold its annual meeting on Jan. 17 in Philadelphia.

The Louisiana Engineering Society will hold its annual meeting on Jan. 13 in New Orleans. The secretary is W. T. Hogg.

The Engineers' Club of Toronto will hold its annual meeting on Feb. 1. The secretary is R. B. Woolsey, 90 King St., West, Toronto, Ont.

The Montana Institute of Municipal Engineers will hold its annual meeting in Helena, Jan. 15 to 17. The secretary is J. N. Edy, Billings, Mont.

The Kansas Engineering Society wil hold its annual meeting Jan. 16 and 17 in Topeka, Kan. The secretary is C. A. Porter, City Hall, Topeka.

The New England Water-Works Association will hold its annual meeting in Boston on Jan. 10. The secretary is Willard Kent, Narragansett Pier, R. I.

The Franklin Institute will hold its annual meeting on **Jan. 17,** the paper of the evening being the "Panama Slides," by Harry Fielding Reid, Baltimore.

The Albany Society of Civil Engineers will hold its annual meeting on Jan. 23, in Albany, at Keeler's Hotel. The secretary is E. G. Raynor, Barge Canal Office.

The Engineers Society of Western Pennsylvania will hold its annual meeting on Jan. 16 in Pittsburgh. The secretary is Elmer J. Hiles, Oliver Building, Pittsburgh.

The American Institute of Consulting Engineers will hold its annual meeting on Jan. 15 at the Engineers' Club, New York City. The secretary is F. A. Molitor.

The Society of Constructors of Federal Buildings will hold its seventh annual meeting in Washington, D. C., Jan. 15 to 18. The secretary is Charles Reed Marsh, Brattleboro, Vt.

The American Society of Swedish Engineers will hold its annual meeting on Jan. 20 in the society's building at 271 Hicks St., Brooklyn, N. Y. The secretary is Erik Oberg.

The American Society of Engineering Contractors will hold its annual meeting Jan. 19 in New York City. The secretary is J. R. Wemlinger, South Ferry Building, New York City.

The Compressed Gas Manufacturers Association will hold its annual meeting Jan. 15 at 120 Broadway, New York City. The secretary is Otto S. King, 120 Broadway, New York City.

The Municipal Engineers of the City of New York will hold its annual meeting on Jan. 24 at the Engineering Societies' Building, New York City. The secretary is George A. Taber.

The Canadian Mining Institute will hold its annual meeting in Montreal on Mar. 7 to 9 at the Ritz-Carlton Hotel. The secretary is H. Mortimer Lamb, Ritz-Carlton Hotel, Montreal.

The Western Paving Brick Manufacturers Association will hold its annual meeting on Jan. 19 and 20 in Kansas City, Mo. The secretary is G. W. Thurston, Dwight Building, Kansas City.

The Illinois Association of County Superintendents of Highways will hold its annual meeting Jan. 18 and 19 at Urbana, Ill., in Engineering Hall of the University. The secretary is Walter E. Emery, Peoria, Ill.

The National Association of Master Gravel and Slag Roofers of America will hold its annual meeting, Dec. 16 and 17, in Washington, D. C. The secretary is H. B. Nichols, Whitehall Building, New York City.

The Central Railway Club holds its annual meeting on Jan. 12 in Buffalo. Election of the following officers will be announced: President, D. R. MacBain; vice-presidents, W. H. Sitterly, David D. Robertson, Frank C. Pickard. The secretary is Harry B. Vought, 95 Liberty St., New York City.

American Concrete Institute—The nominating committee has named the following candidates to be voted on at the annual meeting, Feb. 9: President, Prof. W. K. Hatt, Purdue University; vice-president, Sanford E. Thompson, Boston, Mass.; treasurer, Robert W. Lesley, Philadelphia, Penn.

The Oklahoma Society of Engineers recently held its annual meeting, at which Alfred Boyd, Dean of the School of Engineering of the Agricultural and Mechanical College of Stillwater, was elected president. M. L. Cunningham, State Engineer, first vice-president; F. B. King, second vice-president; J. P. Cloutz, third vice-president; H. V. Hinckley, Oklahoma City, secretary.

The Engineers' Society of Western Pennsylvania.—C. R. Yarnall, vice-president of the Nelson Valve Co. and of the Engineers' Club of Philadelphia, recently addressed the Engineers' Society of Western Pennsylvania on "Engineering Coöperation and Fellowship." He explained the methods and spirit by which the Engineers' Club of Philadelphia was able to put through its campaign for increasing its membership a year ago. Since the campaign the membership has increased—by 200.

The American Institute of Mining Engineers—The list of nominees submitted by the Committee on Nominations stands as printed in this column on Dec. 7, with the exception that C. W. Goodale, Butte, Mont., has been nominated for vice-president in place of Walter H. Eldridge, New York, who declined, and that Philip N. Moore, of St. Louis, has been nominated by petition for president. Sidney J. Jennings had already been named by the Nominating Committee as a candidate for president.

The National Lime Manufacturers Association will hold its 31st annual convention in New York City, Feb. 6 and 7, at the McAlpin Hotel. An unusual attraction will be the second American Complete Building Show, which will be held in Grand Central Palace. As in former years the American Ceramic Society, the National Paving Brick Manufacturers Association, the National Clay Machinery Association and the

National Building Brick Bureau will meet at the same time, in New York City. The secretary is Fred K. Irvine, 537 South Dearborn St., Chicago.

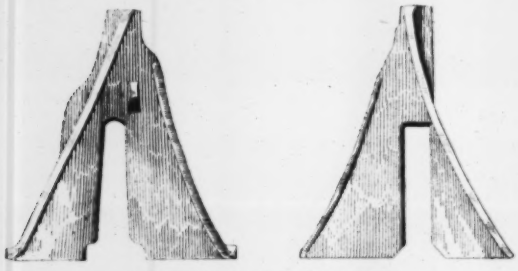
The American Society of Civil Engineers will hold its annual meeting on Wednesday, Jan. 17, in the auditorium of the Engineering Societies' Building, 29 West 39th St., New York City. This is the first annual meeting of the society to be held elsewhere than in its own building. In the evening a reception with dancing will be held in the Society House, 220 West 57th St. On Thursday there will be an excursion on the Hudson and East Rivers, starting at 10 a.m. from the ferry slip at the foot of Whitehall St. Thursday evening, John Howard Whitehouse, M.P., will speak at the Society House on "The Economic Conditions in England Due to the War." Following his address there will be a smoker.

American Institute of Weights and Measures—An association has been formed in New York City to oppose the compulsory use of the metric system. The constitution defines the objects of the association as the "maintenance and improvement of our present English system of weights and measures for the good of our commerce and industry and the well-being of our country," and "the promotion of wise legislation for the conservation of our basic English unit of weights and measures and opposition to hasty and ill-considered legislation involving changes from our fundamental English standard." In a circular letter just issued the Institute declares its belief that an organized effort is being made to force the adoption of the metric system in the United States by compulsory legislation. It urges that before any such legislation is undertaken it should be ascertained whether in the countries using the metric system the old standards do not still continue in use with resultant confusion. The Council of the Institute includes such prominent men as E. M. Herr, President of the Westinghouse Electric Co.; Henry M. Leland, President of the Cadillac Motor Car Co.; William Lodge, President of the Lodge & Shipley Machine Tool Co.; Henry B. Sharpe, Treasurer of the Brown & Sharpe Manufacturing Co.; Stevenson Taylor, President of the American Bureau of Shipping; Henry R. Towne, head of the Yale & Towne Manufacturing Co.; Worcester R. Warner, Vice-President of the Warner & Frazee Co., and D. H. Kelly, Secretary of the Toledo Scale Co. Those interested in the objects of the association are invited to apply for membership to any member of the Council.

Appliances and Materials

Wrecking Frog or Car Replacer

The Johnson car replacers, shown herewith, straddle the rail, with the narrow end resting on the rail head and the wider end on the rail base and ties. They retain their position without the use of spikes or clamps. The central flat portion (slotted for the rail) forms an incline, up which the



JOHNSON CAR REPLACER

derailed wheels ride, while the ribs guide them into position on the rails. They are openhearth steel castings weighing from 30 lb. each (for light logging or industrial lines) to 165 lb. for heavy locomotives, or 275 lb. each for 200-ton wrecking outfits. These replacers are handled by Clapp, Norstrom & Riley, of Chicago.

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New Type of High-Speed High-Vacuum Pump

A new kind of pump for exhausting vacuum tubes, etc., has been developed by Irving Langmuir of the Research Laboratory of the General Electric Co., Schenectady. The most notable performance characteristics are (1) extreme speed (3,000 to 4,000 c.c. per sec.), (2) simplicity and reliability, and (3) absence of a lower limit above zero to which the pressure may be reduced.

The operating scheme is novel: A blast of mercury vapor carries the gas by friction into a condenser chamber, the gas and vapor always being inclosed by cooled walls so that there can be no re-evaporation of vapor condensing thereon. (Where such re-evaporation takes place there is a backward diffusion which prevents the outward passage of the gas to be exhausted.) Because of this action and its vital importance the new exhausters have been termed "condensation pumps."

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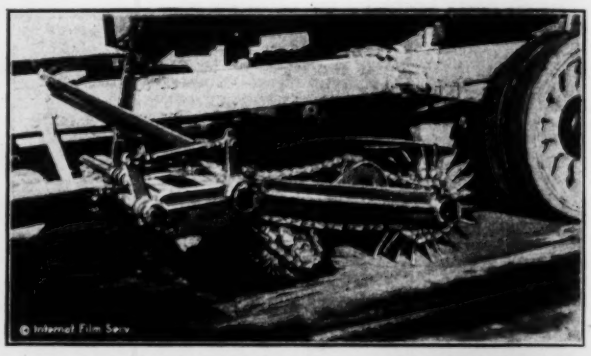
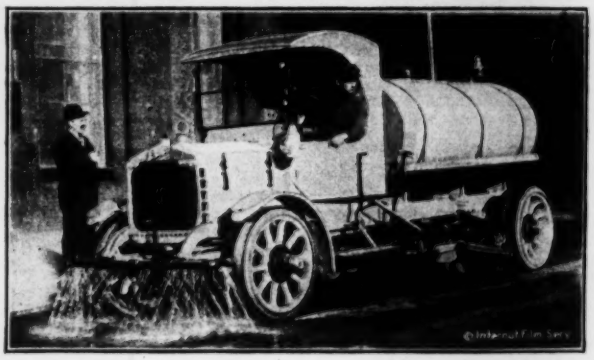
Motor Squeegee Street Washer

A demonstration was recently given in New York City of a motor-driven street-cleaning apparatus that combines a sprinkler, a broom and a squeegee. This machine is known as the "Sterling-Kindling Motor Squeegee Street Washer" and is made by the Sterling Motor Truck Co., of Milwaukee. It consists primarily of a special Sterling worm-gear-driven motor truck, carrying a 1000-gal. tank (see accompanying view). Ahead of the front fenders is a sprinkler pipe. Under the body of the truck are a second sprinkler pipe and a rotary sweeper broom, which may be let down in contact with the pavement, to loosen the dirt. Behind this and revolving in an opposite direction is a squeegee 19 in. in diameter and 8 ft. long, with helical rubber blades.

The squeegee roller and broom are flexibly mounted and counterbalanced in such a way that, when adjusted to a certain pressure against the street surface, the pressure remains uniform over inequalities of surface. A toggle-joint linkage terminating in a lever in the driver's cab makes it possible to throw the broom and squeegee driving attachment in and out of engagement quickly or to lift them out of contact with the pavement. They are driven from a secondary shaft of the truck transmission, which operates a worm gear that turns a wheel and shaft carrying the sprockets and chains. The tank is fitted with a water meter. This serves both to indicate the amount of water used (and thus the operator's industry) and in connection with a cyclom-





STERLING-KINDLING MOTOR SQUEEGEE STREET SWEEPER AND WASHER

eter, to give data for computing water consumption per square yard of pavement cleaned. The tank is equipped with separate valves near the front end for distributing water to the front and central sprinklers. The machine may be converted into a flusher by substitution of nozzles for the sprinklers.

The cleaning capacity of the machine per day is claimed to be from 80,000 to 115,000 sq.yd., which is about 25 mi. of ordinary streets. This is the equivalent of from three to six horse-drawn street-cleaning equipments. A test by the Municipal Research Bureau of Milwaukee gave an average of 80,000 sq.yd. of pavement cleaned per day, at an average cost of 16.5c. per 1000 sq.yd.